Climate Change Vulnerability Assessment in Selected Coastal Communities in Mozambique

Final Report

Consultant: Dinis Juízo & Clemêncio Nhantumbo

Date: May 26, 2022

Acronymos and abbreviations

AHP – Analytical Hierarch Approach

CCVA – Climate Change Vulnerability Assessment

CCVI – Climate Change Vulnerability Index

NGOs – Non- Governmental Organization

REM – Maputo Special Reserve

RPMPO – Ponta do Ouro Partial Marine Reserve

SWIOFC – Southwest Indian Ocean Fisheries Commission

WIOSAP – Wastern Indian Ocean Strategic Action Plan

Sumário Executivo

As alterações climáticas são um problema global que se refere a mudanças de médio de longo prazo de temperatura e de precipitação, associadas ao aumento do nível médio das águas do mar, bem como à acidificação dos oceanos. Para além da mudança nos valores médios observados, as mudanças do clima estão igualmente associadas à intensificação de eventos extremos, como cheias e secas, danificando infraestruturas, causando mortes, fome, entre outros. As zonas costeiras estarão mais expostas a riscos associados ao aumento do nível do mar com consequente perda de terra no litoral. Moçambique, é um país em desenvolvimento, localizado na costa leste de África, portanto considerado um dos países mais vulneráveis às miudanças climáticas. Embora as mudanças climáticas e os seus impactos sejam eminentes, a vulnerabilidade das comunidades costeiras de Moçambique não é bem conhecida, limitando assim a implementação de medidas adaptação apropriadas.

A vulnerabilidade às mudanças climáticas pode diferir em diferentes regiões devido a vários factores que incluem (1) tipos de pressões e suas intensidades; (2) sensibilidade do ecossistema e comunidades; e a (3) capacidade adaptativa. Além disso, as diferenças devido às circunstâncias locais e às abordagens metodológicas limitam a replicabilidade dos métodos de Avaliação da Vulnerabilidade às Mudanças Climáticas e dificulta a comparação dos Índices resultantes.

O objetivo deste estudo é actualizar os métodos existentes de Avaliação de Vulnerabilidade às Mudanças Climáticas considerando as circunstâncias locais das Comunidades Costeiras de Moçambique e testar o método de análise de vulnerabilidade actualizado em dois locais, a (1) Baía de Maputo, incluindo Inhaca, e (2) Xai-xai incluindo a área estuarina do Limpopo. Várias reuniões de especialistas de Moçambique, Quênia, Tanzânia e Madagascar – foram realizadas para discutir e harmonizar métodos de Avaliação de Vulnerabilidade às Mudanças Climáticas, tendo como base as propostos nas publicações de (Thiault, et al., 2021; Gurney & Darling, A Global Socio-Ecological Systems Monitoring Framework for Coastal Fisheries Management - A Practical Monitoring Handbook, 2017 ; Feldmeyer, et al., 2021), para chegar ao método de avaliação da Vulnerabilidade às Mudanças Climáticas aplicado neste estudo. O método acordado para Avaliação da Vulnerabilidade às Mudanças Climáticas incluí, um Índice de vulnerabilidade, baseado em dimensões, domínios e indicadores. Os pesos e valores dos indicadores e domínios foram determinados através de questionários, que fazem parte do método proposto para a Avaliação da Vulnerabilidade às Mudanças Climáticas.

O Índice de Vulnerabilidade Climática foi calculado para quatro comunidades nos dois locais de estudo (1) Baía de Maputo incluindo Inhaca e (2) Xai-xai incluindo o Estuarino do Limpopo e os valores são: -0,079 para Gazene, -0,042 para Cumbane -0,035 para Farol e 0,187 para Mahielene. Em geral, o domínio de subsistência e aprendizagem

contribuem mais para o Índice de Vulnerabilidade as Vulnerabilidade às Mudanças Climáticas em todas as comunidades de estudo. Gazene é a comunidade mais vulnerável entre as comunidades estudadas seguida de Cumbane, Farol e por último Mahielene.

O diferença no grau de sensibilidade duma comunidade pode estar relacionada com a natureza das actividades que a sustentam, que é principalmente a pesca para Gazene e a agricultura para Cumbane. No caso das comunidades de Farol e Mahielene elas desenvolvem em combinaçao a agricultura assim como a pesca como meio de sustento das famílias. Todavia, a diferença no grau de vulnerabilidades entras as comunidades estudadas não é expressiva, por isso todas elas devem ser consideradas no desenvolvimento do plano de adaptação. No entanto, deve ser dada mais prioridade a Gazene, seguido de Cumbane, Farol e por último Mahielene.

Os indicadores que mais contribuem para a sensibilidade, por terem pesos e pontuações mais altos em quase todas as comunidades, são: situação de emprego, percentagem de renda da actividade principal, valorização da biodiversidade, dependência nutricional, enquanto os indicadores que mais contribuem para a capacidade adaptativa, são: o acesso à informação, infraestrutura comunitária, capacidade de mudança, nível de participação, adaptação para viver sem pesca e confiança nas organizações em quase todas as comunidades. Adicionalmente, a capacidade adaptativa tem uma contribuição significativa de vinculação de capital social, para Gazene e Mahielene, e coesão comunitária para Gazene e Farol, por terem ambos, pesos e valores elevados.

Principais Recomendações

Para melhorar os Índices de Vulnerabilidade às Mudanças Climáticas, reduzindo a sensibilidade e aumentando a capacidade adaptativa, devem ser priorizadas acções que influenciem os indicadores dos domínios de subsistência, aprendizagem e organização. Isso não significa que as acções relacionadas a outros domínios devam ser negligenciadas, principalmente porque a manipulação de factores que se evidenciam numa análise, pode levar a uma nova interação dinâmica entre as comunidades e os recursos do que dependem, com potencial para o surgimento de novos riscos não conhecidos ou vivenciados anteriormente. Na prática, a Adaptação deve ser vista como um processo contínuo, onde a cada instante se faz uma avaliação da situação de vulnerabilidade da comunidade pós-intervenção e determinar novas medidas ou reforçar as que se mostrem adequadas. Há também que considerar que as Ferramentas de Vulnerabilidade às Mudanças Climáticas propostas neste estudo ainda estão em teste e que a sua efectividade em determinar os factores preponderantes a serem alvo dum programa de fortalecimento da capacidade adptativa aos impactos das mudanças climáticas.

Como resultados deste estudo, recomenda-se as intervenções prioritárias devem actuar visando aumentar o desempenho dos seguintes indicadores: situação de emprego, percentagem de renda da actividade principal, valorização da biodiversidade, dependência nutricional, nível de escolaridade, conhecimento de regras, estilo de vida material, acesso a créditos, multiplicidade de meios de subsistência, artefactos de pesca e reconhecimento de casualidades. Além disso, a ligação entre capital social e coesão comunitária deve ser considerada no conjunto de internveções nas comunidades de Farol e Mahielene, respectivamente.

As acções específicas que podem ajudar a melhorar o desempenho nos indicadores listados acima incluem as que visam (1) a criação de empregos, (2) a diversificação de fontes de renda, (3) melhoria da compreensão do valor da biodiversidade, aumentando assim a vontade de participar de acções que protejam os ecossistemas, (4) melhoria do acesso a alimentos de qualidade, (5) melhoria do nível de educação das comunidades locais, (6) melhoria do conhecimento e o reconhecimento de regras que visam a preservação dos recursos naturais e do ecossistema, como regras que definem os locais onde as pessoas não devem pescar, apetrechos de pesca, períodos em que as pessoas não deveriam pescar e espécies de peixes afectadas, (7) facilitar que as pessoas tenham bens, (8) facilitar o acesso a créditos, (9) aumentar o número de opções de subsistência, (10) facilitar o acesso a diferentes artes, pois aumenta a possibilidade de captura de recursos marinhos, tornando as comunidades capazes de se adaptar a novos métodos em caso de mudanças causados pela redução da disponibilidade de recursos, (11) reconhecimento da gestão que afecta a disponibilidade e qualidade dos recursos marinhos, aumentando assim a vontade das comunidades de participar na gestão. Para Farol, deve-se igualmente priorizar-se as acções que visam melhorar os bens e serviços fornecidos com base nos impostos pagos pelas comunidades, como infraestruturas públicas, incluindo estradas, hospitais e escolas e para a Mahielene, deve-se considerar também acções de sensibilização que motivaram as pessoas da comunidade a ajudar um ao outro.

As actividades que visam reduzir a vulnerabilidade das comunidades estudadas estão alinhadas com as ações prioritárias listadas na Estratégia Nacional de Adaptação e Mitigação às Mudanças Climáticas de Moçambique, que são: 4.6.1.1 Redução do Risco das Mudanças Climáticas, que incluem o melhoramento do sistema de aviso prévio, e a capacidade, bem como a preparação para responder aos impactos das mudanças climáticas; 4.6.1.2 Recursos Hídricos, que incluem o aprimoramento da gestão dos recursos hídricos, bem como o acesso, captação, armazenamento, tratamento e distribuição de água; 4.6.1.3 Agricultura, pesca, segurança alimentar e nutrição, que incluem, aumentar a resiliência da agricultura, pecuária, pesca, bem como garantir a segurança alimentar e nutricional.

A relação entre vários componentes do sistema socioecológico é complexa e não pode ser totalmente capturada nestes métodos de avaliação de vulnerabilidade às mudanças climáticas. A implementação de medidas de adaptação com base nos resultados da avaliação da vulnerabilidade às mudanças climáticas pode levar a feedback indesejado e resultados inesperados. A implementação das acções que visam melhorar o padrão de vida das comunidades locais pode levar a riscos indesejados, como (1) consumo excessivo e superexploração dos recursos do ecossistema, levando ao seu colapso, e (2) estabelecimento de comunidades aparentemente estáveis mas extremamente sensível as mudanças extremas, que são inevitáveis, como a perda de bens e serviços das pessoas durante uma cheia. Outros possíveis resultados indesejados podem ser listados, porém, esses aspectos devem ser cuidadosamente abordados para todas as acções, planeadas e/ou implementadas para melhorar a capacidade adaptativa ou reduzir a sensibilidade das comunidades de estudos ou outras.

Executive Summary

Climate change is a global problem that refers to medium to long-term changes in temperature and precipitation, associated with rising of the sea level, as well as ocean acidification. In addition to the change in the average values observed, climate changes are also associated with the intensification of extreme events, such as floods and droughts, damaging infrastructure, causing deaths, hunger, among others. Coastal areas will be more exposed to risks associated with rising sea levels with consequent loss of land on the coast. Mozambique, is a developing country, located on the east coast of Africa, therefore considered one of the most vulnerable countries to climate change. Although climate change and its impacts are imminent, the vulnerability of Mozambique's coastal communities is not well known, thus limiting the implementation of appropriate adaptation measures.

Vulnerability to climate change may differ in different regions due to several factors including (1) types of pressures and their intensities; (2) ecosystem and community sensitivity; and (3) adaptive capacity. In addition, differences due to local circumstances and methodological approaches limit the replicability of the Climate Change Vulnerability Assessment methods and make it difficult to compare the resulting Indices.

The purpose of this study is to update the existing Climate Change Vulnerability Assessment toolkit considering the local circumstances of the Coastal Communities of Mozambique and test the updated vulnerability assessment method in two locations, (1) Maputo Bay, including Inhaca, and (2) Xai-xai including the Limpopo estuarine. Several meetings of experts from Mozambique, Kenya, Tanzania and Madagascar – were held to discuss and harmonize Climate Change Vulnerability Assessment toolkit, based on the methods proposed in publications by (Thiault, et al., 2021; Gurney & Darling, A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management - A Practical Monitoring Handbook, 2017; Feldmeyer, et al., 2021), to arrive at the Climate Change Vulnerability assessment toolkit applied in this study. The agreed toolkit for Assessing Vulnerability to Climate Change includes a vulnerability index, based on dimensions, domains and indicators. The weights and values of the indicators and domains were determined through questionnaires, which are part of the proposed Climate Change Inerability Assessment Toolkit.

The Climate Vulnerability Index was calculated for four communities in the two study sites (1) Maputo Bay including Inhaca and (2) Xai-xai including the Limpopo Estuarine and the values are: -0.079 for Gazene, -0.042 for Cumbane - 0.035 for Farol and 0.187 for Mahielene. Overall, the livelihoods and learning domain contribute most to the Climate Change Vulnerability Index in all studied communities. Gazene is the most vulnerable community among the communities studied, followed by Cumbane, Farol and finally Mahielene.

The difference in the degree of sensitivity of a community may be related to the nature of the activities that sustain it, which is mainly fishing for Gazene and agriculture for Cumbane. In the case of the communities of Farol and Mahielene, agriculture in combination with fishing sustain the families. However, the difference in the degree of vulnerability between the communities studied is not significant, so all of them must be considered in the development of the adaptation plan. However, more priority should be given to Gazene, followed by Cumbane, Farol and lastely Mahielene.

The indicators that contribute most to sensitivity, as they have higher weights and scores in almost all communities, are: employment status, percentage of income from the main activity, appreciation of biodiversity, nutritional dependence, while the indicators that most contribute to the adaptive capacity, are: access to information, community infrastructure, perceived capacity to change, level of participation, adapt to live without fishing and trust in organizations in almost all communities. Additionally, adaptive capacity has a significant contribution to linking social capital, for Gazene and Mahielene, and community cohesion for Gazene and Farol, as they both have high weights and values.

Key Recommendations

To improve the Climate Change Vulnerability Indexes, by reducing sensitivity and increasing adaptive capacity, actions that influence indicators in the livelihood, learning and organization domains should be prioritized. This does not mean that actions related to other domains should be neglected, mainly because the manipulation of factors that become evident in an analysis can lead to a new dynamic interaction between communities and the resources they depend on, with the potential for the emergence of new ones. risks not known or previously experienced. In practice, Adaptation should be seen as a continuous process, where an assessment of the vulnerability situation of the post-intervention community is carried out at every moment and new measures are determined or those that prove to be adequate are reinforced. It should also be considered that the Vulnerability to Climate Change Tools proposed in this study are still being tested and that their effectiveness in determining the preponderant factors to be targeted by a program to strengthen the adaptive capacity to the impacts of climate change must be considered.

As a result of this study, it is recommended that priority interventions should act to increase the performance of the following indicators: employment status, percentage of income from the main activity, appreciation of biodiversity, nutritional dependence, level of education, knowledge of rules, lifestyle material, access to credits, livelihood multiplicity, gear and recognition of casualty. Furthermore, the link between social capital and community cohesion must be considered in the set of interventions in the communities of Farol and Mahielene, respectively.

Specific actions that can help improve performance on the indicators listed above include those aimed at (1) job creation, (2) diversification of income sources, (3) improving understanding of the value of biodiversity, thus increasing the willingness to participate in actions that protect the ecosystem, (4) improving access to quality food, (5) improving the level of education of local communities, (6) improving knowledge and the recognition of rules aimed at preserving natural resources and the ecosystem, such as rules defining where people should not fish, fishing gear, periods when people should not fish and affected fish species, (7) facilitating people's possession of assets, (8) facilitating access to credits, (9) increase the number of livelihood options, (10) facilitate access to different arts, as it increases the possibility of capturing marine resources, making communities able to adapt to new methods in case of changes caused by reduced availability of resources, (11) recognition of management, as affecting the availability and quality of marine resources, thus increasing the willingness of communities to participate in management. For Farol, priority should also be given to actions that aim to improve the goods and services provided based on taxes paid by communities, such as public infrastructure, including roads, hospitals and schools, and for Mahielene, actions to awareness raising that motivated people in the community to help one another.

The activities aimed at reducing the vulnerability of the communities studied are in line with the priority actions listed in Mozambique's National Climate Change Adaptation and Mitigation Strategy, which are: 4.6.1.1 Reducing the Risk of Climate Change, which include improving the system of early warning, and the capacity and preparedness to respond to the impacts of climate change; 4.6.1.2 Water Resources, which include improving the management of water resources, as well as access, capture, storage, treatment and distribution of water; 4.6.1.3 Agriculture, fisheries, food security and nutrition, which include increasing the resilience of agriculture, livestock, fisheries, as well as ensuring food and nutrition security.

The relationship between various components of the socio-ecological system is complex and cannot be fully captured by climate change vulnerability assessment methods. Implementing adaptation measures based on the results of the climate change vulnerability assessment can lead to unwanted feedback and unexpected results. The implementation of actions aimed at improving the life standard of local communities can lead to undesired risks, such as (1) excessive consumption and overexploitation of ecosystem resources, leading to its collapse, and (2) establishment of apparently stable but extremely sensitive communities. extreme changes, which are unavoidable, such as the loss of people's goods and services during a flood. Other possible undesired outcomes may be listed, however, these aspects must be carefully addressed for all actions, planned and/or implemented to improve adaptive capacity or reduce sensitivity of studies communities or others.

Contents

1. Introduction

Coastal communities have there subsistence base threatened more than ever as a results of increased pressures from the growing population interweened by the impacts of climate change. Climate change will indeed lead to significant modifications of the functions of coastal ecosystems that communities depend on. There are several factors that impact the sustainability of coastal ecosystems some belonging to the human systems and others to the natural systems. It is known that huma and natural system interact in a very complex way and at different scales of space and time (Gunderson & Holling, 2002). Undesirable negative feed-backs between society and ecosystems are like to worsen under climate change scenarios (D'agata, et al., 2020).

This study entails: (1) description of the intensity of climate changes threats and identification of potential impacts, relative to the capacity of the interacting human and ecological systems to cope with such threats; (2) identification of communities that are most vulnerable to climate change and its impacts and assist in crafting adaptation plans to help lift those communities that will be severely affected to a state of enhanced resilience. The activities of this assignment include (1) gathering and analysing of social and economic data relevant to the Climate Change Vulnerability Assessment (CCVA) of local communities dependent on major coastal ecosystems and developing knowledge management products, (2) identify specific adaptation technology needs, and national plans with a focus on the needs of coastal communities, (3) mapping of risks and possible responses to extreme climatic events, identify potential networks for the sharing of information on successful adaptation, and (4) contribute to management and policy option on climate change necessary for decision making. Further, the assignment provides for the definition for inclusion of coastal and marine adaptation options in climate change policies at national level suited to country context and contribute to the enhancement of critical habitats, conservation and sustainable marine conservation networks explicitly supporting the social and economic sustainability of coastal communities.

Lliterature (Tress, Bär, Tress, & Fry, 2006) and documentation review of experiences with implementation of CCVA reveals that, due to the broad nature of the subject, its execution requires expertise in different areas including hydrology, water quality, socio-economics, biology and climate change, whom are best equipped to perform specialist assessments of changes in precipitation, water flows, water quality, biota due to climate change and its impact on communities, enabling the identification of suitable adaptation and mitigation actions. For these reasons to optimize in time and achieve a better result this study was conducted by a team of experts assisting the main consultant in implementing this assignment.

1.1 Purpose of the report

The purpose of this report is to present the methods results and main conclusions that resulted from the implementation of CCVA at two sites, the (1) Maputo Bay, including Inhaca, and (2) Xai-Xai including Limpopo Estuarine area. This report gives a summary of activities implemented during the assignment, including, the description of study area, sites context, methods and approach of

data collection and processing. Since the data collection is based on formal interviews and surveys, the questionnaires proposed in the MACMON monitoring Guide (Gurney & Darling, A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management: A Practical Monitoring Handbook, 2017) were updated based on the dimensions, domains and indicators defined in Thiault, et al. (2021) and aligned to the specific contexts of the communities and ecosystems where data was collected to evaluate the indicators presented in this report.

2. Methods

2.1 Approach used for the assignment

The assignment included two satges, the first was updating and piloting the CCVA Toolkit and the second was to evaluate the socio-ecological climate changes vulnerability using a proposed framework in literature (Gurney & Darling, A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management - A Practical Monitoring Handbook, 2017). The assessment framework is constructed hierarchily of three levels; staring with (1) dimensions of analyses that encompass several (2) domains and lastly each with its set of (3) indicators. Because each domain and indicators contributed differently to the overall assessment of dimension, it is required to assign weights that will enable the aggregation of results in the determination of the dimension score. In this assignment with applied the Analytic Hierarchy Process (AHP) proposed by (Saaty, 1980), a common Multi-criteria decision tool used to identify stakeholders' preferences within the natural resources management (Huang, Keisler, & Linkov, 2011). The information for determination of weights of domains and indicators was collected using a questionnaire administered to an assembled focus group and is given in appendix 5. Key information for CCVA was collected during the field visits using two questionnaires, (1) Key Information Interviews and (2) Global Households Survey. The size of the surveyed sample was determined based on the size of the community.

The implementation of the CCVA toolkit in Mozambique is part of a regional initiative supported by SWIOFC and WIOSAP action plans of the Nairobi Convention. The CCVA toolkit is being tested in four WIO countries and required harmonized methods. Thus, regular technical meetings were organized by the WIOSAP secretariate to enable participants share consultants and experiences with the implementation of the process. For efficiency often, there would be allocation of tasks to specific consultant to prepare or organize methods to be used across different case studies.

The fieldwork was guided by the methodological approaches developed by Thiault, et al. (2021), a set of relevant indicators were identified and discussed with partners from Kenya, Madagascar and Tanzania. The final harmonized questionnaires were used across the four participant countries.

Following the implementation of fieldwork in the four countries the team convened to analyse the data and compare results. For the determination of the vulnerability index the AHP (Saaty, 1980)) was adopted for weighing the degree of importance of the different indicators, domains, and dimensions. The result was an aggregated scoring of two important dimensions (sensitivity and adaptive capacity) determining the status of a community in terms of ability to cope under climate change. The detailed review of the contributing factors to the vulnerability provides the basis for identification of needed adaptation measures that will increase the resilience of community to climate change.

The results of this CCVA can influence SWIOFC project activities, enabling the programme to prioritise interventions that have higher probability of building resilience and at the later stage, monitoring of project impacts of planned intervention in that project.

The activities of the assignment were grouped in three phases:

2.2.1 Phase I – Planning and Desk Review

To ensure the timely implementation of project activities the experts conducted a review of the CCVA toolkit followed by collection of relevant information. Right at the begining of the work it was found that the CCVA Toolkit required a significant and intense revisions of data collection and processing tools. This required several online meetings with partners from Kenya, Madagascar, and Tanzania for harmonization of the toolkit to enable inter-comparability of results, facilitate the regional analysis of the key vulnerability issues facing the coastal communities of the Wester Indian Ocean. The harmonization meetings led into delays on the workplan. Nevertheless, the delays and intense work required are counterweighted by the result that is a solid and easy to use tool, that can be easily scalled up for implementation across the region.

During this preparatory phase the team of experts involved in the study in Mozambique prepared and submitted a detailed workplan. The workplan included (1) number of site visits, logistical needs, information collected and/or delivered, including questionnaires; (2) proposal of content to the manuscript; (3) and the list of main deliverables.

2.1.2 Phase II – Field visits and Pilot the CCVA Toolkit

This phase focused on collecting information for the overall CCVA, as well as developing detailed methodologies for analysis of risks and opportunities, including technologies, in the studied sites. The Overall CCVA information was collected using the questionnaire referred to above, (1) Key Informant interviews and (2) Global Households Survey. In addition to obtaining commensurable results and enabling the comparison of the vulnerability level across different communities surveyed, the team conducted focus group discussion followed by administration of a specific questionnaire to knowledgeable people. This questionnaire was part of the application of the AHP, this technique is based in the organization of the decision-making problem in a hierarchical structure, resulting in ranked relative importance of its elements by using a pair-wise comparison system.

2.1.3 Phase III – Reporting

At this phase the final project report was prepared and submitted, including the scientific journal manuscript. A short summary report in Portuguese was also be prepared to inform the policy makers on the results of the assignment. The summary report in Portuguese makes the results of the assignment acceessible to decision makers at national level.

2.2 Study area

Mozambique is located in the southern coast of East Africa with 2470 km of coastline and rich and productive continental area of about 102.300 km^2. Its coastline is characterized by wide diversified habitats including sandy and rocky beaches; sand dunes, coral reefs, estuaries, bays, seagrass beds and mangrove forest, which support the ecosystem with high biological productivity (Pereira, et al., 2014). The coastline can broadly be classified as 1) coral coast, 2) swamps and 3) parabolic coastal dunes (Pereira, et al., 2014).

The longitudinal range of the Mozambican coastline, as well as the diversity of habitats and ecosystems, support high biodiversity. Several ecological areas of regional and global importance have been identified along the coast. Almost 900 species of reef-associated fishes have been recorded, 122 species of sharks and rays, 400 species of molluscs, 27 species of marine of mammals, including viable population of dugongs, five species of marine turtles, 270 species of hard and soft corals, 14 species of seagrasses and ten species of mangroves (Pereira, et al., 2014). Seagrass meadows in Mozambique cover an area of 439 km^2, and generally occur in the intertidal zone. The most important sites for the conservation of this ecosystem and associated species are the Quirimbas Archipelago, Bay Fernão-Veloso, the Bazaruto Archipelago, and the island of Inhaca, one of the study areas of this assignment, and Ponta do Ouro.

Approximately 60% of the country population resides in the first 80km of the coastline. The major treats to the coastal and marine ecosystem of Mozambique include overfishing, industrial and coastal development, natural resources exploration, unregulated and damaging tourism practices, population pressure and weather extreme events, such as storms and cyclones (Pereira, et al., 2014).

There are three main types of fisheries in the Mozambican coastline: Industrial, semi-industrial and artisanal. The fisheries sector plays an important role in the economy, contributing with 3% of Gross Domestic Product (GDP) and 4% of global national exports (Pereira, et al., 2014). Commercial fisheries, industrial and semi-industrial, exploit the most important and valuable resources such as shallow and deep-water shrimp and pelagic fish species, such as tuna, billfishes and sharks. Artisanal fishery occurs along the entire coast and captures shallow water demersal and pelagic species using traditional gears being the important source of food and employment of the coastal communities, which represents more than two-thirds of the population of Mozambique (Pereira, et al., 2014). Artisanal fisheries, involves 18% of woman that are depending directly or indirectly on fishing related activities (Pereira, et al., 2014).

The study areas for this assignment are Maputo Bay, including Inhaca and Xai-Xai, including Limpopo Delta, Figure 1. The study sites were selected aligned with the sites of the ***National Demonstration Activities of the SWIOFC-Nairobi Convention Partnership Project in Mozambique***.

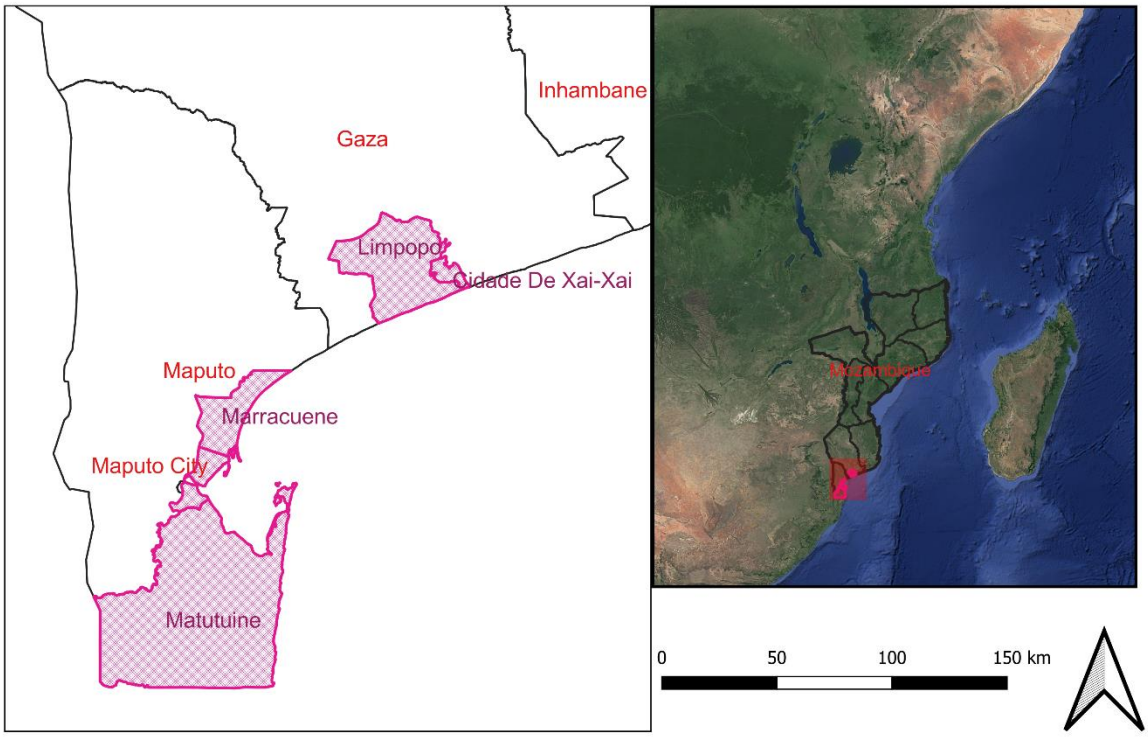


Figure 1 Study Area: Maputo bay including Inhaca and Xai-xai Including Limpopo

2.2.1 Maputo Bay including Inhaca

Maputo Bay is in southern Mozambique, it includes the coastal part of Maputo and Matola cities, forming the largest metropolitan area of the country, the area also has the largest commercial port of the country. It also includes the Districts of Marracuene and Matutuíne, where the Maputo Special Reserve (REM) and the Ponta do Ouro Partial Marine Reserve (RPMPO) are located, and are part of the Libombo Transboundary Conservation area, which links to the Isimangaliso Park (Wetland) in South Africa, named a heritage site for humanity.

The Coastal and marine ecosystems in the Bay include extensive mangrove systems; extensive banks of seaweed, coral reefs and dune forests (Paula, Macamo, & Bandeira, 2014; Fernando, Bandeira, & Guissamulo, 2014; Schleyer & Pereira, 2014). The main fishing resources include shallow water shrimp and other crustaceans, small pelagic and large pelagic fish and demersal rock fish, operated by small scale fishers including commercial vessels (Silva & Masquine, 2014; Inácio A. , Leong, Samucidine, Masquine, & Paula, 2014). These ecosystems are strongly influenced by urban and industrial activities.

According to the work plan for ***national demonstration activities of the SWIOFC-Nairobi Convention Partnership Project in Mozambique***, in general terms the proximity with Maputo and Matola cities allows the coastal communities to have diversified sources of income. However, there are remote communities located in Machangulo (Matutuíne), Inhaca and Marracuene that rely mostly on fisheries, agriculture and tourism for their livelihoods. The selected SWIOFC´ project pilot sites, include 3.650 households and a total population of 18.252.

2.2.1 Xai-Xai city including Limpopo Estuarine Area

The Limpopo River Estuarine Area is located in Gaza Province, includes the communities in the districts of Limpopo, Zongoene Administrative Post, and Xai-Xai, Chilaulene Administrative Post. This area is the only one in Gaza province where mangrove forests strieves in the banks of the Limpopo River together with dune vegetation along the coastal line (Bandeira & Balidy, 2016; AWARD, 2018). Aquatic vegetation in addition to the mangrove ecosystem, includes macroalgae systems on rocky reefs.

The mangrove forest of the Limpopo was, in the 1980's, known to cover only 387 ha, even though the Limpopo is the second largest river in Mozambique, after Zambezi. However, recent research revealed a historical mangrove cover of 928 ha, of which 382 ha (41.2%) are quite pristine and 546 ha (58.8%) are degraded (Bandeira & Balidy, 2016). The mangrove in the Limpopo estuary is made up of trees (individuals) over 100 year old mangrove. In year 2000, a major flooding developped from cacthment upstream causing significant morfological changes in the system increasing the width of the river from around 200 meters to several kilometers, drowning the mangrove forests for about 45 days, and causing sediment transformation and mangrove forest degradation, uprooting and dieback. The mean annual discharge of Limpopo River is usually 170 m^3 /s. However, during the floods of 2000, the river exhibited a peak upstream flash of 16 515 m^3 /s. Property and livelihoods were affected in the basin. This prompted actions for mangrove rehabilitation in 2010 using species *Avicennia marina, Bruguiera gymnorhiza, Ceriops tagal, Rhizophora mucronata* and *Xylocarpus granatum*, with 26.3 ha replanted from 94 453 seedlings out of 168 367 produced in the nursery with 74% survival rate (Bandeira & Balidy, 2016).

In the workplan for the ***SWIOFC*** Project in Mozambique, it is stated that the amount of sediment brought by the river has dropped significantly, due to the increased modification of flow regime associated with the operation of the dams upstream (Massingir Dam). This hinders the fixation and natural survival of young plants in the substrata. It is also stated that, the impact of salinization is affecting agriculture and diversity of fish species. In the Limpopo River Mouth area, there are fishing resources such as crustaceans, with emphasis on shrimp and mangrove crab, small and large pelagic fish, as well as demersal fish.

In this project area of the ***SWIOFC*** Project in Mozambique, it covers a population of around 5.770 households of a population of about 28.852 inhabitants that depend mostly on agriculture and fisheries. Livestock is also a relatively important livelihood.

2.3 Sample size

The studied community or sites were selected from the relevant coastal villages in the study areas Maputo Bay, including Inhaca and Xai-Xai, including Limpopo-Estuarine. The villages relevant for this study are distributed in five districts whose households are predominately engaged in fishing, fish trade, gleaning, mangrove cutting and trade. The target localities for this study are distributed in 5 (five) main villages, being two located in Xai-Xai district within the Limpopo estuarine (Limpopo

and Xai-xai city) and three in Maputo Bay (Marracuene and Inhaca) see details in Table 1. However, due to resources and time constraints, only four communities were covered in this study. To estimate the number of households for the survey in table 1, it was assumed that one household contains in average five people, this is the standard used by the National Statistics Institute in Mozambique. The communities for the study were selected from table 1 after close consultation with Key Informants, to ensure that the strata's listed below are included.

As agreed in with other consultants of this pilot initiative, the sample size is calculated using the following standard formula for infinite population (Naing & Winn, 2006) :

$$n = z^2p(1- p)/e^2$$

Where n is the sample size, z is the statistical certainty chosen at 95% confidence level (z = 1.96) for an error risk of 5%, p is estimated level/coverage to be investigated, chosen at p = 0.5, e is precision desired, expressed as a fraction of 1, usually e = 0.05 is chosen for the confidence interval. The output is corrected for finite population using the formula (Naing & Winn, 2006):

$$n_1 = n/(1+n/N)$$

Where n_1 is the sample size for finite population, N is the target population of fishing, fish trade, gleaning, and mangrove cutting, and trade and n is the calculated sample size from infinite population. A sampling interval (SI) of two is calculated by dividing the total population by the sample size.

When the target community had large population hence large number of households a meticulous procedure was adopted for picking the respondents. The target population was first divided into strata based on main household occupations that are linked to marine resources namely households that depend on fishing, fish trade, and mangrove wood trade. Systematic random sampling was applied to select the number of households that represent the target population from the identified strata. The respondents were systematically picked from the sample using the sampling interval to ensure that there are equal chances for each household in the target population to be included in the study (Khotari, 2004). This sampling technique would generate a representative sample that allows generalization to a larger population and the usage of inferential statistics. For smaller community, say with less than 60 households, all households are preferred as it is was more difficulty to implement a segregated systematic random sampling.

Table 1 Communities, population and sample size required for each relevant community in the study areas

Study Area	District	Administractive Post	Village	Population	Number of households	Theoretical Sample size households	Sampling Interval	Selected villages
Maputo Bay including Inhaca	Marracuene	Macaneta	Macaneta	3602	720	251	3	No
			Mbuva	780	156	111	1	No
			Macaneta II	1188	238	147	2	No
			Hobjana	800	160	113	1	No
			Matsinane	1025	205	134	2	No
			Ilha Xefina	169	34	31	1	No
			Ilha Mbemgueleni	137	27	26	1	No
			Gazene	**149**	**31**	**28 (28 inter.)**	**1**	**Yes**
		Total		**7701**	1540	**307**	5	
	Inhaca	Inhanca	**Farol**	**1750**	**350**	**184 (184 inter.)**	**2**	**Yes**
			Others	4751	951	274	3	No
		Total		6505	1301	457	3	No
	Catembe		Katembe/ Costa do Sol/ Matola (20%)	36315	7263	365	20	No
		Total		**36315**	**7263**	**365**	20	
	Matutine	? Bela Vista	Santa Maria (PA Machangulo)	647	129	97	1	No
			Maphanga	687	137	101	1	No
			Mhala	176	35	32	1	No
			Ngomene	338	68	57	1	No
			Ndelane	117	23	22	1	No
			Mabulucu	449	90	73	1	No
			Ticalala	100	20	19	1	No
			Mucombo	366	73	61	1	No
			Chivambo	179	36	33	1	No
			Tsolombane	70	14	14	1	No
			Muvucuza	91	18	17	1	No
			MiliBangalala	68	14	13	1	No
		Total		**3288**	**658**	**242**	3	
Xai-xai including Limpopo Estuarine	Limpopo	Chicumbane	Avoz da frelimo B1 (WIOSAP)	1745	349	183	2	No
			Avoz da frelimo B2 (WIOSAP)	1417	283	163	2	No
			Avoz da Frelimo B4 (WIOSAP)	1601	320	175	2	No
			Avoz da frelimo B3 (WIOSAP)	1402	280	162	2	No
			Avoz da frelimo B5 (WIOSAP)	643	129	96	1	No
		Total		**6808**	**1362**	**300**	5	
		Zonguene	Zongoene B2 (WIOSAP)	1948	390	193	2	No
			Zongoene B3 (WIOSAP)	2727	545	225	2	No
			Zongoene B4 (WIOSAP)	3117	623	238	3	No
			Zongoene B5 (WIOSAP)	1050	210	136	2	No
		Total		8842	1768	316		
	Xai-xai	Xai-xai City - Chilaulene (?)	Nhancumene (WIOSAP)	809	162	114	1	No
			Zimilene (WIOSAP)	2503	501	217	2	No
			Salvador Allende (WIOSAP)	7036	1407	302	5	No
			Mahielene (WIOSAP)	**1243**	**249**	**151(only 42 inter.)**	**2**	**Yes**
			Cumbane (WIOSAP)	**480**	**52**	**46 (50 interv.)**	**1**	**Yes**
		Total		11823	2365	330		

2.4 Indicators

Vulnerability can be assessed through three broad dimensions: exposure, sensitivity, and adaptive capacity (Thiault, et al., 2021). All three dimensions' influence vulnerability however, especially in social-ecological vulnerability assessments, the division between these dimensions is not always clear. Because dimensions provide the higher level, first tier, underpinnings for implementing vulnerability-based management, i.e., reducing exposure, decreasing sensitivity, and/ or building adaptive capacity, it is crucial that the meaning of each dimension within a specific context of the analysis is clearly stated (Thiault, et al., 2021). For each of the deminsion a set of indicators can be used to evaluate its status across different communities and conditions. The indicators should be carefully selected to represent the real stressors that will be representative of the condition, this is often translated into a score used appropriated techniques, that will be described in following sections of the report.

Climate stressors used to describe indicators may include precipitation change (press) and extreme marine heat events. In addition to climate stressors, exposure domains may derive from environmental, economic, or other external pressures (Thiault, et al., 2021). Social sensitivity to environmental change can be disaggregated into four domains (economic dependency, demographic dependency, psychological dependency, and cultural dependency), and social adaptive capacity relied on five domains (assets, flexibility, social organization, learning, and agency) (Thiault, et al., 2021), table in appendix 1. The suitable set of indicators to use in determining the level of vulnerability across these different domains will be informed by the prevailing characteristics of the studied communities and ecosystems.

For this particular case of selected sites in Maputo bay and Xai-Xai including Limpopo Estuarine Area, we predominately found (1) extensive mangrove that encompass the coral reefs, extensive banks with seagrass; (2) people dependent on coastal ecosystem services, particularly fisheries, water for agriculture and livestock. Thus is was concluded that all indicators proposed in table of Appendix 1 are relevant and were used for the CCVA. In the methology applied in this study vulnerability index of a community is computed by substracting the overall score of its sensitivity in the total scores of adaptive capacity.

In the scope of the current study the exposure dimension and its indicators have not been considered. This dimension represents the externally acting forces that influence the state of the

environment and related ecosystems in the area. When analysed it gives the perspective or degree of severity of the threats and loss that a particular community would experience in the event of climate change or extreme (Gurney G. G., et al., 2019; Gurney & Darling, A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management: A Practical Monitoring Handbook, 2017).

In a greater detail, (Gurney & Darling, A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management - A Practical Monitoring Handbook, 2017) presents a methodology on socio-ecological monitoring guide for conducting the CCVA in coastal areas that has inspired the work of this study. The tools presented in that guide were combined with own authors review of similar experiences to develop the CCVA methodology for this assignment.

The explanation of domains in the context of this assignment is provided in the table in Appendix 1. The Appendix 2 presents the list of indicators, explanations and methods for data collection and scoring. The data collection for determination of the scores for the indicators is done based on the household survey, Appendix 2.

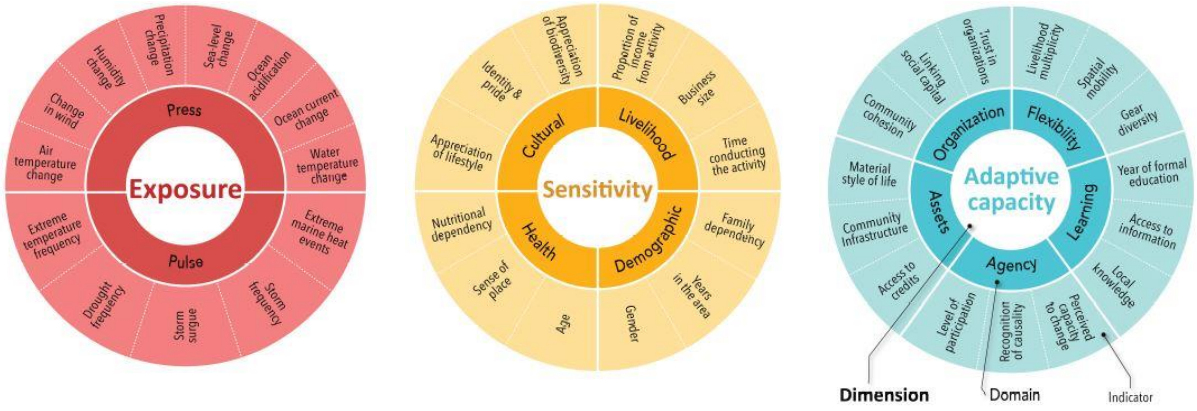


Figure 2: Conceptual diagram illustrating the three proposed nested layers for theoretically and contextually grounded vulnerability assessment (Thiault&al2021)

2.5 Questionnaire and procedures

Three questionnaires implemented during the survey were: (1) the Key Informants Questionnaires to get a qualitative information; (2) Household survey Questionnaire, to get both qualitative and quantitative information that will allow the determination of scores of the indicators; and the (3) Focus group questionnaire, aiming to determine the weights of domains and indicators using the AHP method (Saaty, 1980).

Vulnerability of coastal communities to climate change was measured on ordinal scale making use of the Likert scale items in a questionnaire that covers social adaptive capacity and sensitivity dimensions. These questionnaires have been designed considering the objectives of the research (Khotari, 2004). The questionnaire consists of two parts with part 1 having both closed and open-ended questions on demographic factors, and part 2 having both Likert scale type of questions and open-ended questions on the main variables in the study. Each of the Likert scale questions in part 2 was assessed on a 5-point scale from 1 to 5 (Warmbrod 2014).

Guided questionnaire administration was adopted in this study to capture a representative sample of the target population, avoid potential non-response bias and control for non-verbal behaviour (Nachmias & Nachmias, 2008). The questionnaire was administered in the respondent's households or acceptable venues over a period between November 2021 and March 2022. The researchers followed the target respondents, whose households are pre-selected through the sampling interval and appointments booked with them in advance where necessary. To ensure accuracy in reporting, each respondent was informed that their personal details would remain anonymous and confidential. The overall purpose and objectives of the study was clearly explained to the respondents and informed consent obtained with a clarification that the questionnaire is being filled on voluntary grounds.

2.6 Data analysis

The main goal of the analysis was to generate scores for the two key domaisn of CCVA analysis, the Sensitivity and the Adaptive Capacity, based on the HH surveys. Since the data collected included responses to end-opened questions and closed questions, the closed questions were converted in scores based on the methods presented in the table in appendix 2. These scores were further standardized to be assigned values of between zero and one. The scores of indicators

were combined using the weights obtained using the AHP method to aggregate score for each of the two dimensions, sensitivity and adaptive capacity. For that, the combined scores for different domains were aggregated using the weights for domains, also determined using the AHP method resulting in the overall scores of each dimension per household, being (1) the sensitivity score and (2) the adaptive capacity score. The final score of social climate change vulnerability index was determined by subtracting the adaptive capacity score by the sensitivity score, figure 3. Finally, the social climate change vulnerability of studied households and communities were compared using the calculated indexes.

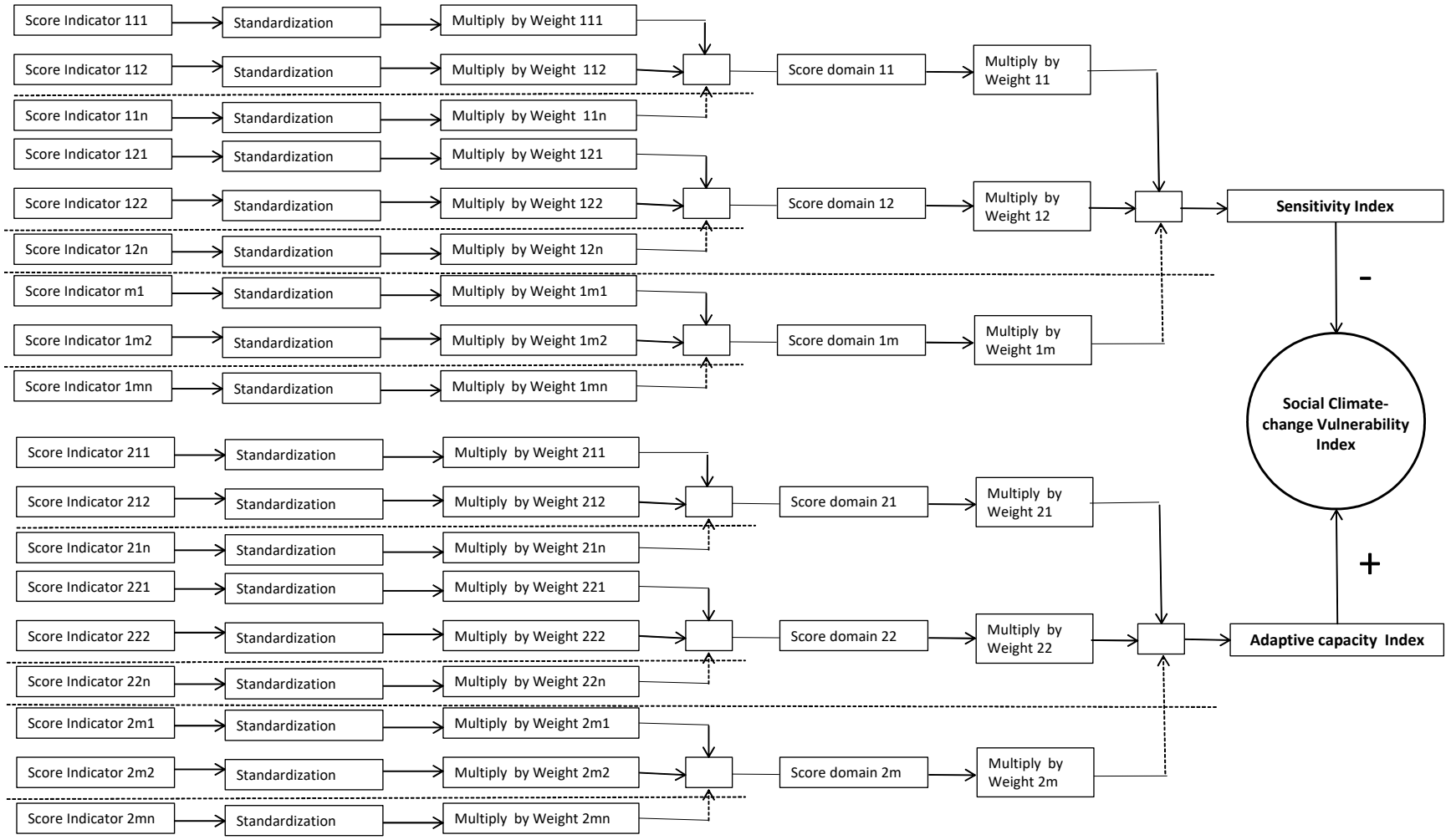


Figure 3 Determination of Social Vulnerability Index

3. Results and discussion

A total of six communities were visited and 312 household heads were interviewed during the study, Figure 4. household for this study is a set of individuals that share the same roof generally composed by a head of household, that can be a man or woman, the wife, or wives (in case the head is a male) and their children. The number of interviews per community shows that only in three of the communities the sample size is statistically significant namely the communities of Gazene, Farol and Cumbane. Considerable sample size was reached in Mahielene that justified the calculation of vulnerability index, while very limited interviews were obtained from Nhaquene and Ribawene, table 2. Several factors contributed to the difficulties in reaching the desirable sample in these three communities namely, the duration and logistics of the study, households not willing to participate in the interviews and the dispersion of the households in the area.

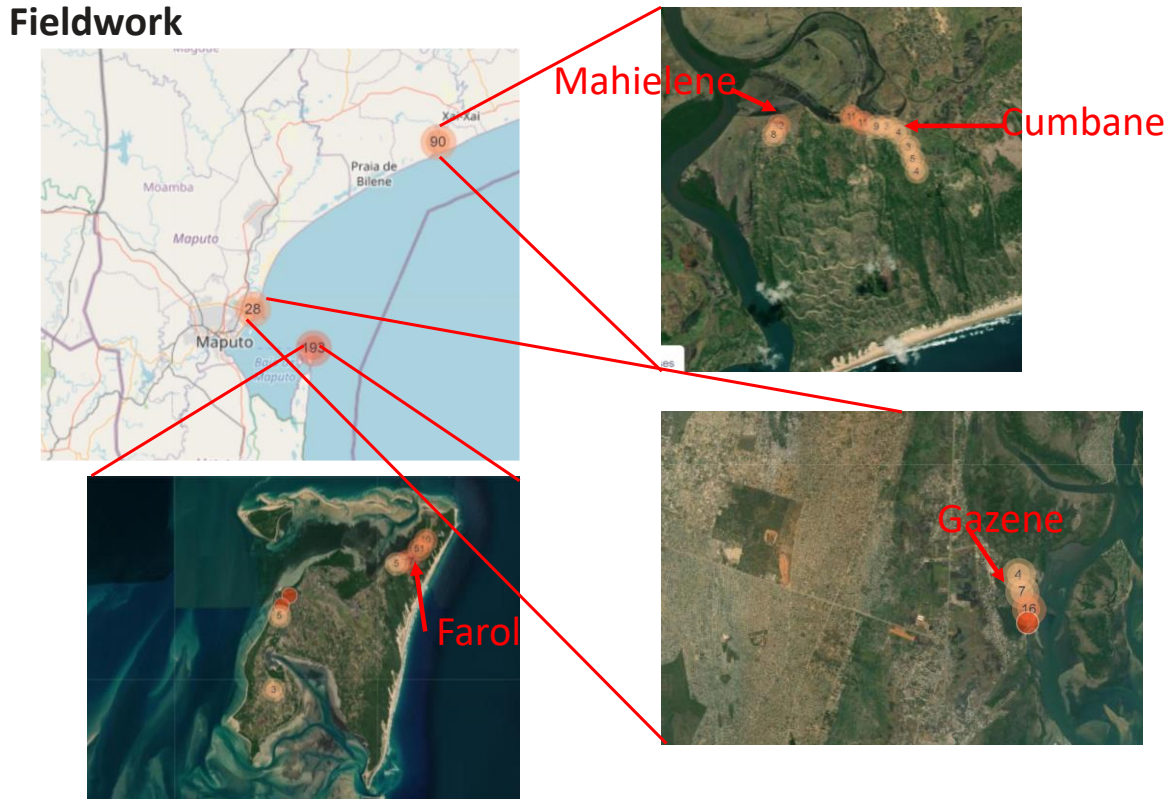


Figure 4. Communities selected for testing the CCVA

Table 2: Number of survey responses per village

Site	Village	Female	Male	Total
Maputo Bay including Inhaca	Gazene	10	18	28
	Nhaquene	1	2	3
	Ribwene	2	6	8
	Farol	70	113	183
Xai-Xai including Limpopo Estuarine	Cumbane	22	28	50
	Mahielene	26	14	40
Total		131	181	312

3.1 Results from the questionnaires

The results of the questionnaires are included in the worksheet 1 of Appendix 6. The number of household members in the studied communities varies significantly, and the average number of household members is 7. Ninety percent (90%) of the household leaders interviewed are aged 20 to 65 years. The other 10% are below 20 years or above 65 years interval making them less likely or limited in options for their adaptation. It is foundt that education is very limited with 80% of household leaders with education below 8th grade.

When asked about climate change, the coastal communities included in the study believe that there are changes on temperatures and seasonal distribution of precipitation. While increased precipitation observed on monsoon season is very limited for other seasons, Figure 5. They also believe that the climate change is affecting the occurrence of floods and droughts however, they also believe it has limited influence on fish catch.

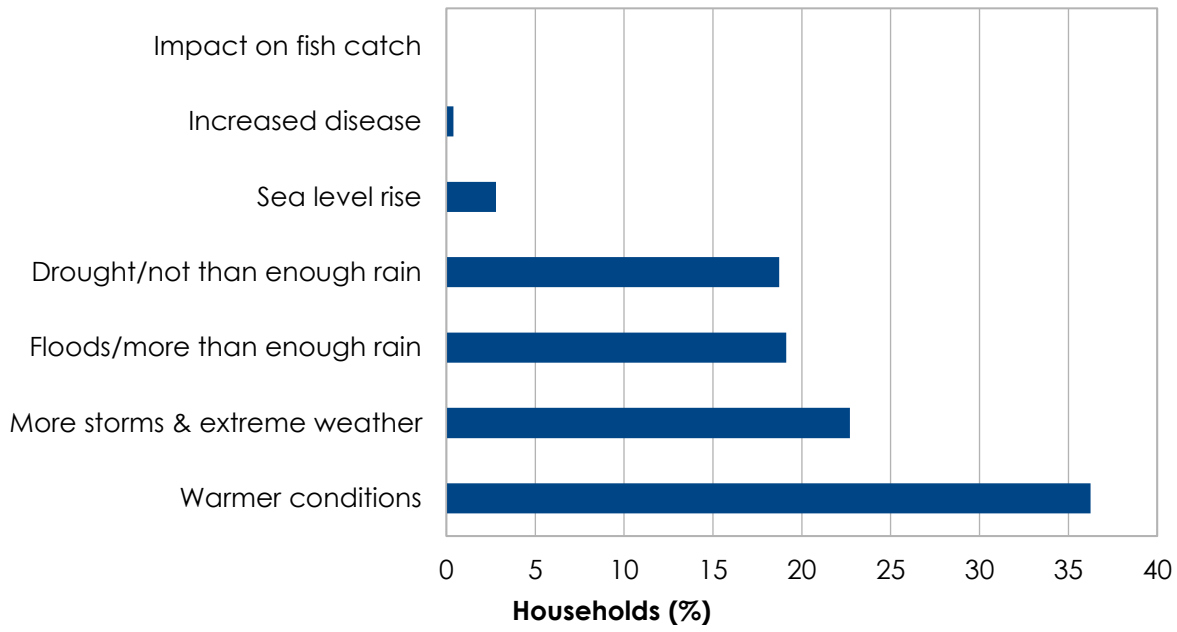


Figure 5. Local perception of climate change impacts

Villagers in Cumbane and Mahielene (Xai-xai in the Limpopo Estuary) complain mostly of the never-ending drought. Changes in precipitation also leads to saline intrusion which hinders the practice of agriculture, endangering food production. Communities in Inhaca are mostly sustained by fisheries and tourism related activities. An interviewed fisherman said that "the fish catch decreased significantly" during the last 5 years due to overexploitation by increased industrial and semi-industrial fishing. Nowadays, the amount of fish catch is roughly stable but the natives and small-scale commercial fishing (up to 100 kg a day per boat) is posing a risk on the sustainability of the resources. Another note is that most fishers work on the pelagic zone on boats with up to 12 crewmembers and capture pelagic fish (tuna and mackerel) and half of the haul belongs to the owner of the vessel. Finally, people from Gazene are extremely dependant on the resources that coast and sea provide, with very few are formally employed.

Eighty four percent (84.3%) of people living in the communities selected for the study are native, with 96.8% living in the villages for more than 5 years (Figure 6). This makes than more attached to the community and less prompt to move to live somewhere else.

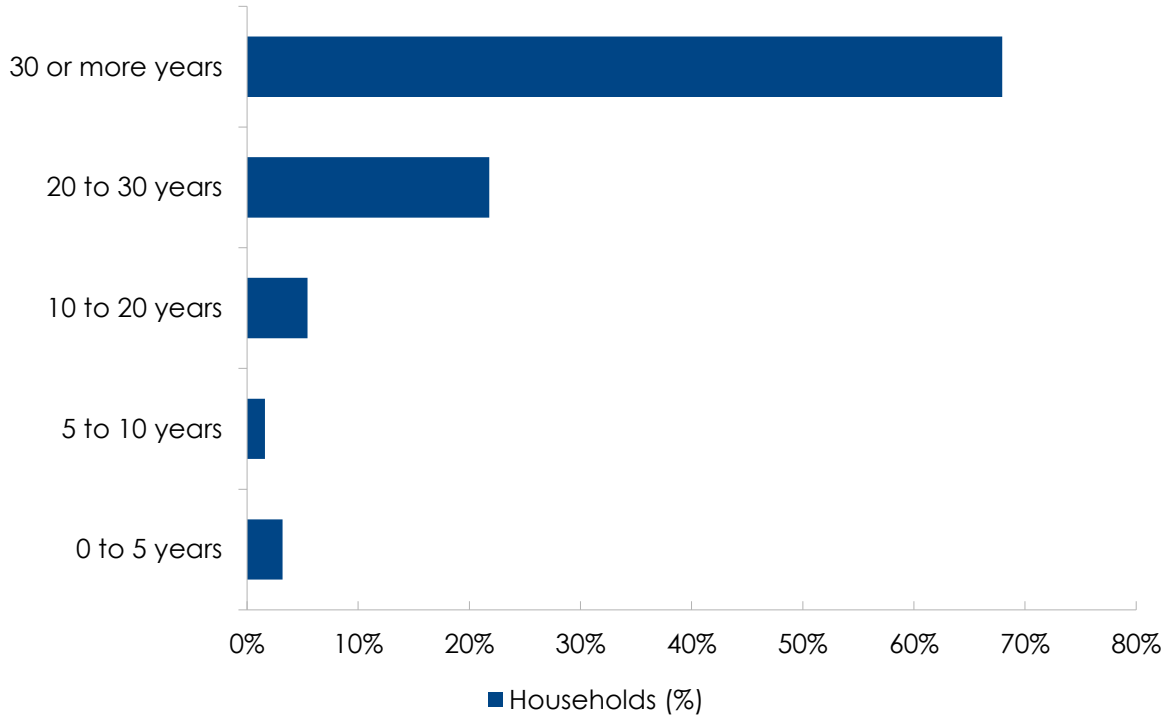


Figure 6. Percentage of households interviewed vs years living in the community

The main activities developed by families in the target communities of this study are fishing, and agriculture, Figure 7. While in some cases households rely only on fishing or agriculture, on other cases the family develops both fishing and agriculture. Other activities, include mainly tourism and regular employment. Gazene, Farol and Cumbane are different in terms ofe activities developed by the household members. Families in Gazene rely on fishing; while families in Cumbane rely on agriculture; and people in Farol and Mahielene practice both agriculture and fishing. It was also noticed that people who came from other villages relied less on agriculture than the natives.

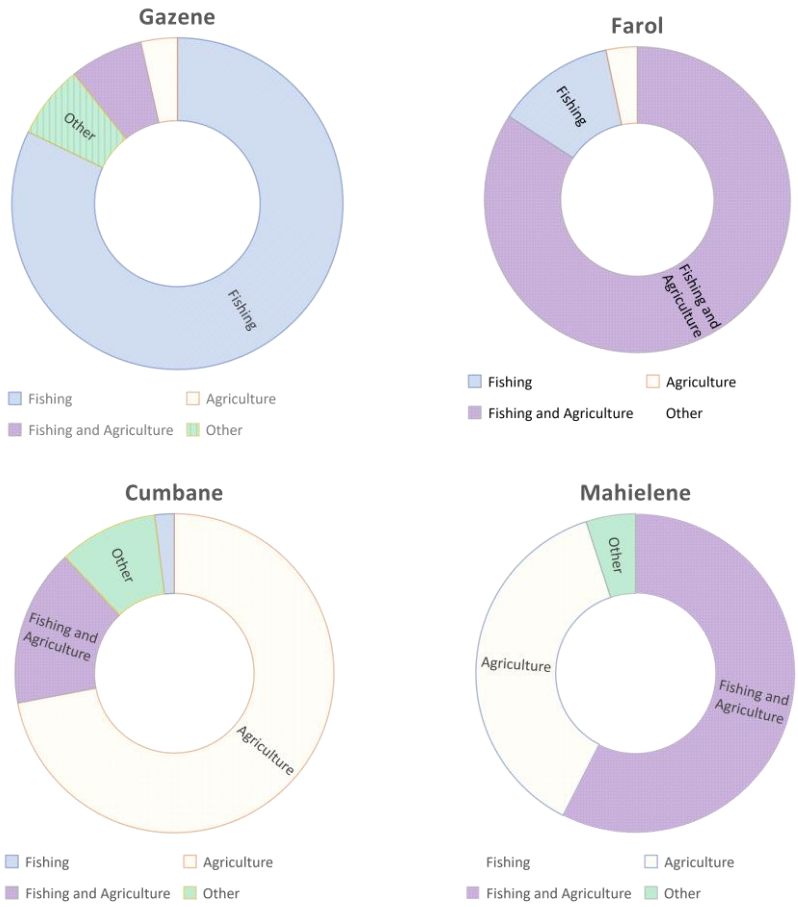


Figure 7. Activities developed by families in the target communities for the CCVA for both, Maputo Bay including Inhaca (Gazene and Farol), and Xai-xai, including Limpopo Estuarine (Cumbane and Mahielene).

In this study it is not possible to perform a detailed analysis of income because most interviewees only reported the income from the main activity or the income of interviewed individual, not the total income of the household. The main reasons for this, is limited information that the household representative has of the other family members income.

An overwhelming majority of people interviewed, about 70%, reported doing much less fishing in the present compared to the last 5 years. Despite that, about 36% of those who fish disagreed strongly that they could stop fishing and earn their livelihood from other activities (Figure 8). About 27% of household leaders agree strongly that they could easily stop fishing and live out of other activities. These is related to the current activities of the communities, Figure 6. It could also be noted that some people were not sure if they could leave without fishing.

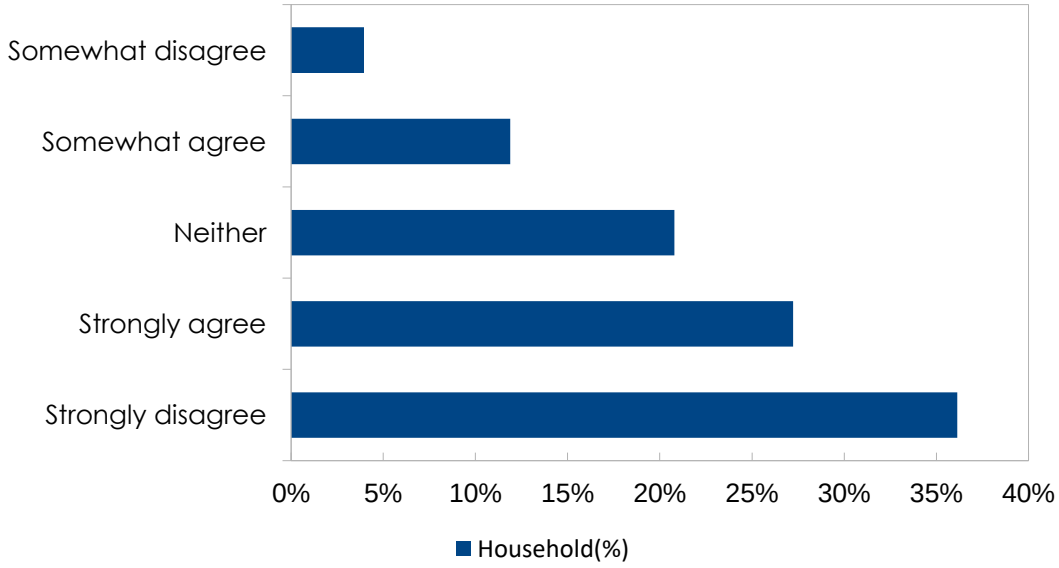


Figure 8. Opinion of interviewed people regarding their ability to live without fishing

Nevertheless, fishing is their most important activity, if fish catch reduces by 50% or more in the area for a year, the majority stated that they could change the fishing ground, and as stated by one interviewed "there is always somewhere with some fish, we just have to keep looking", Figure 9. While some household leaders said that they would continue fishing the reduced amount others said he not yet on what they would do.

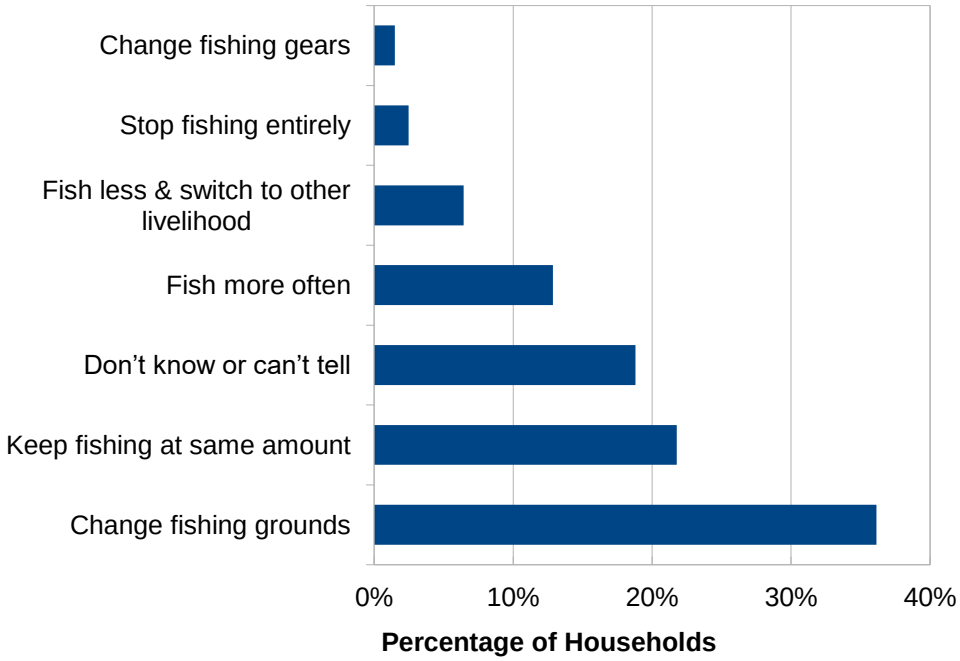


Figure 9. Opinion of interviewed people regarding what they would do if the fish catch reduced by 50% or more.

Regarding to trust in government, organisations, NGOs, marine resources management group, village leaders and people in the village, the following scores are attributed for different answers: Not at all (0%), distrust more people than trust (25%), about half-half (50%), trust more people than distrust (75%), and trust at all (100%). The average score was calculated for the interviewed people and is shown in Figure 10. Interesting fact is that the household leaders trust the government, village leaders and people in the village when compared to NGOs and marine resources management groups.

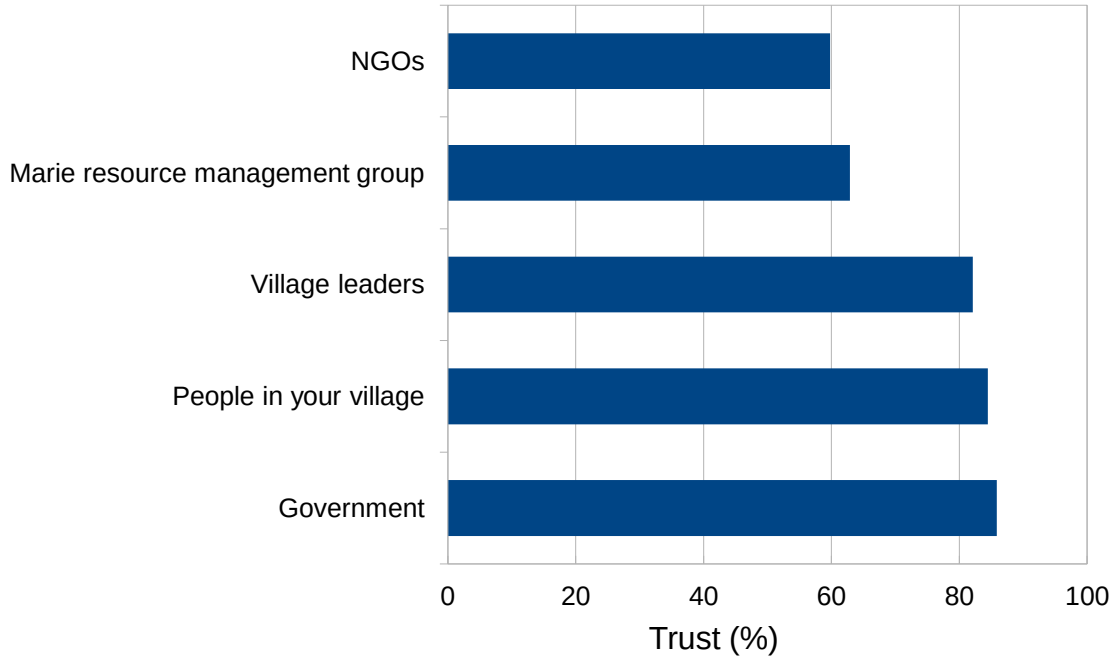


Figure 10. Opinion of interviewed people regarding trusting in government, NGOs, Marine resources management group, village leaders and people in their village.

3.2 Analysis of vulnerability Index, adaptive capacity and sensitivity

Data and analysis done to arrive at the climate change vulnerability index are included in the Appendix 6. The vulnerability index is result of values of indicators and the associated weights. The climate change vulnerability index is computed at household level, using the methods described in chapter 2.6. For all communities studied the adaptive capacity fairly tally much the sensitivity, Figure 11. However, Gazene seems a bit more sensitive compared to Farol, Cumbane and Mahielene, with livelihood, that is influenced by activities developed by local communities, such as, fishing, contributing more to the sensitivity, Figure 13. This might be explained by the fact that housholds from Gazene are mainly dependent on fishing, Figure 7. Farol is the second community with reasonable high sensitivity which is second community with households depending on fishing only, followed by combined agriculture and fishing, with very limited agriculture only, Figure 7. Cumbane and Mahielene do not have households that relay on fishing only. In Cumbane most households relay on agriculture only and some combine agriculture and fishing, while in Mahielene, most households relay on combined fishing and agriculture, followed by agriculture only, Figure 7.

In general livelihood contributes significantly to the overall sensitivity and if the focus is to reduce sensitivity, effective actions should these aiming to improve the value of indicators within the livelihood domain. While the organization and learning influence more the overall adaptive capacity and if the interest is to improve the adaptive capacity actions should be implemented that target the indicators of these domains. This does not necessarily perclude actions that aim to improve the performance of other domains should be neglected.

Figure 11. Contribution of dimensions and domains to the overall climate change vulnerability index.

2.6.1 Analysis of weights

As stated before, the relative importance of domains and indicators were determied using AHP method and is expressed by weights. In the dimension of ***sensitiviy***, the domain of ***livelihood*** was given more importance compared to ***demographic***, ***cultural*** and ***health***; while in the dimension of ***adaptive capacity*** nevertheless, ***learning*** and ***organization*** were given relatively higher importance, all domains were given relatively same weights, figure 12.

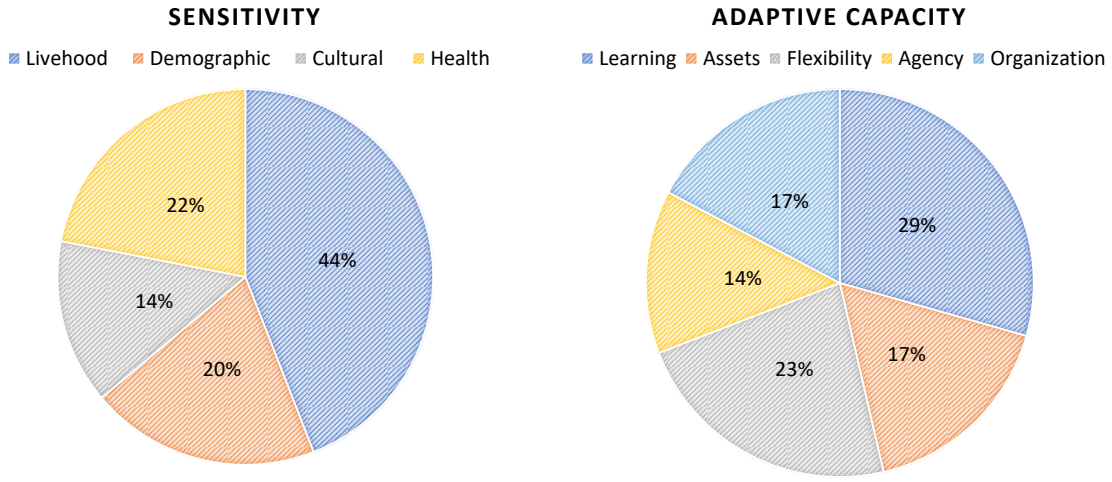


Figure 11. Contribution of weights domains to the overall sensitivity and adaptive capacity dimensions.

The contruibution of different indicarors within the domains that are part of the ***sensitivity*** dimension were farther compared. For indicators within the **livelihood** domain, the ***percentage of catch from fish sold*** was given more importance compared progressively to **percentage of income from the main activity**, ***employment status*** and ***time conducting the activity***; for ***demogrephic*** domain, ***the years living in the village*** was given more importance while compared progressivele to ***percentage of childern in family members***, ***family depedency*** and **gender**; for **cultural** domain, ***the appreciation of biodiversity*** was given more importance compared to ***identity of pride*** and ***appreciation of lifestyle***; and for the domain of ***health,*** the ***nutritonal dependecy*** was given more importance while compared to ***age*** and ***sense of place***. Based on weights only, it is expected that the **appreciation of biodiversity** and **nutitional dependency**, indicators influence more the overall ***sensitivity***, when compared to others.

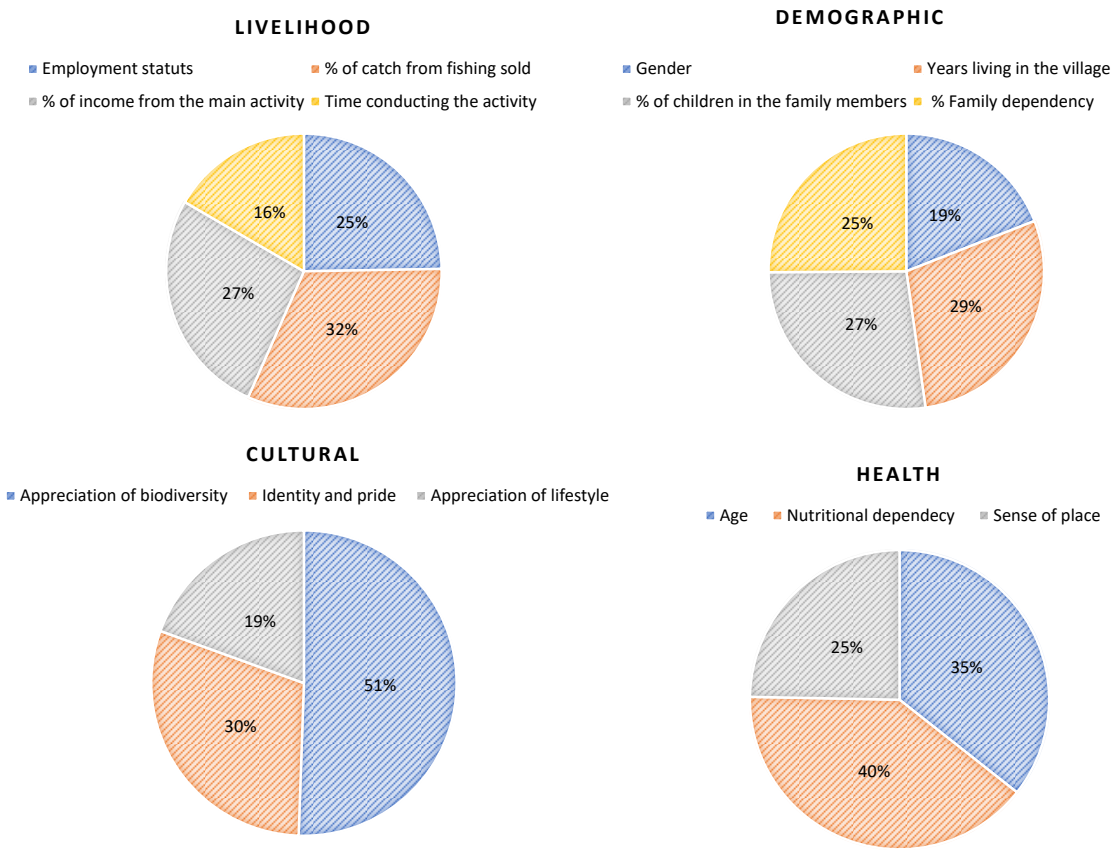


Figure 13. Contribution of indicators weights within the domains of the sensitivity sensitivity dimensions.

The contruibution of different indicarors within the domains that are part of the adaptive capacity dimension were farther compared. The indicators within the ***learning*** domain (***level of education***, ***learning*** and ***access to information***) were given equal importance; for the ***assets*** domain, the ***community infrustriucture*** was given more importance compared to ***material style of life*** and ***access to credits***; for the ***flexibility*** domain, however not significant the ***community infrustructure*** was given more importance compared to ***adapt to live without fishing***, ***gear*** and ***spatial mobility***; for the ***agency*** domain the ***level of participation*** , was given more importance, followed by ***recogniton of casuality*** and lastly ***preceived capacity to chang***; and for the ***organization*** domain, ***community cohesion*** was given more importance compared to ***trust in organzations*** and ***linking social capital***. Based on weights only this makes the ***community cohesion***, ***community infrustructure***, and ***knowledge of rules***, indicators influence more the overall ***adpative capacity***.

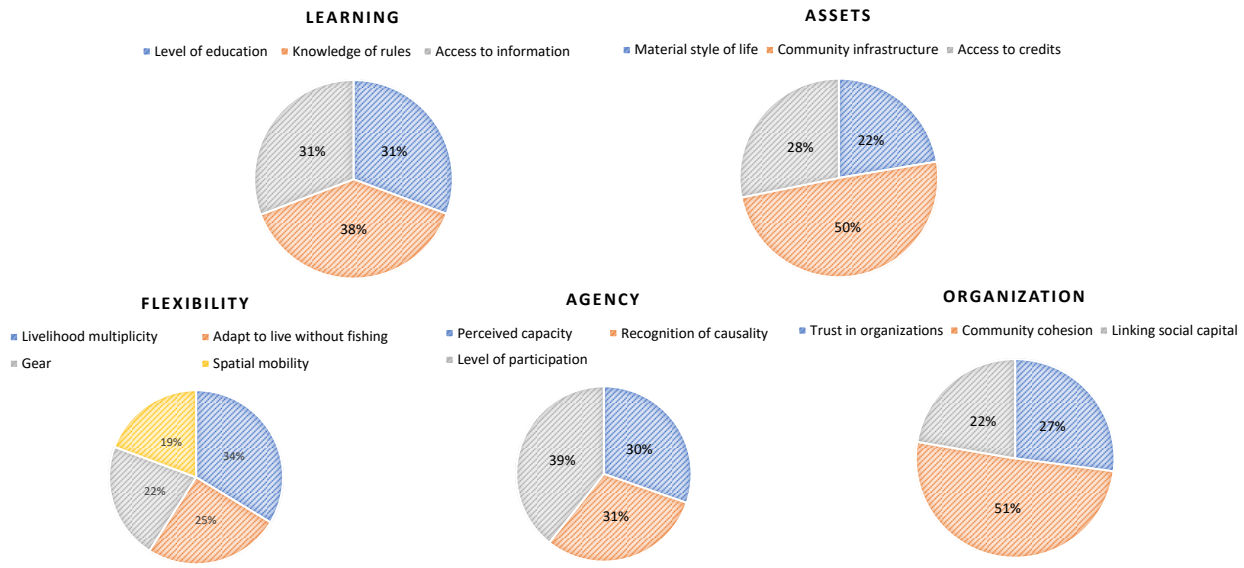


Figure 14. Contribution of indicators weights within the domains of the adaptive capacity dimensions.

3.1.1 Analysis of indicators scores

Comparison of scores of indicators of the sensitivity dimension are presented in figure 15. Higher scores for the ***livelihood*** domain were obtained for ***employment status*** and ***percentage of income from the main activity*** for Farol, Cumbane and Mahielene when compared to ***time conducting the activity*** and ***percentage of catch from fish sold***, this makes these indicators more important because higher importance (weights) were also attributed to the same indicators, discussion above. For the ***demographic*** domain the ***years living in the village*** had higher scores compared to ***gender*** and ***percentage of children in the family members*** for Farol, Cumbane and Mahielene, and the ***family dependency*** scores were much lower, while the associated weights, presented above, were quite even. For ***cultural*** domain **appreciation of biodiversity** and ***appreciation of lifestyle*** had higher scores compared to ***identity of pride***. As ***appreciation of biodiversity*** had both higher weight and score, it contributes more to the overall ***sensitivity***. For the ***health*** domain, Cumbane and Mahielene had higher scores for ***food security and well-being*** (***nutritional dependency***) while ***sence of place*** had higher sore for Farol. Again, the ***nutritional dependency*** was given more importance and score, thus contributing more for the overall ***sensitivity***. Regarding to Gazene, all indicators had quite even scored for all domains.

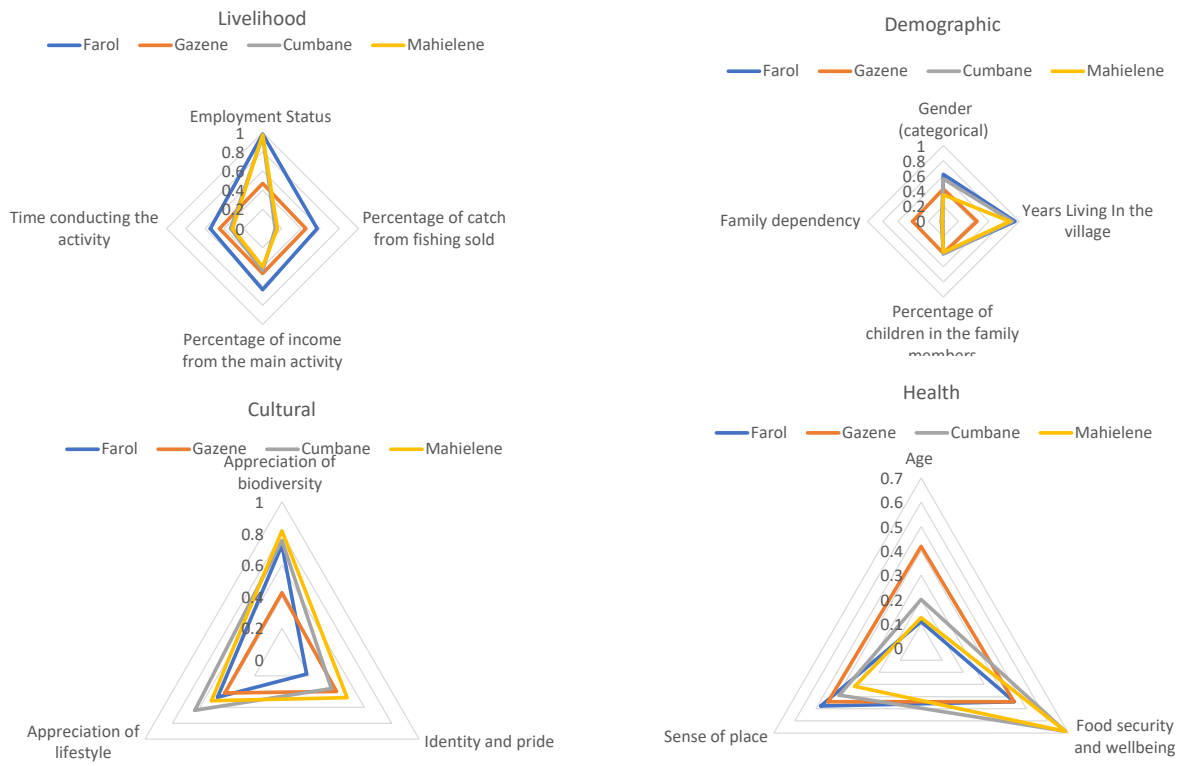


Figure 15. Contribution of indicators scores within the domains of the sensitivity dimension

For Gazene, all indicators had quite even values of scores, with exception of ***level of participation*** within the ***agency*** domain and ***linking social capital*** within the ***organization*** domain that had a bit higher scores compared to other indicators within the same domains. For the ***learning*** domain, the ***access to information*** had higher scores compared to other indicators (***level of education*** and ***knowledge of rules***) in Farol, Cumbane and Mahielene, while the same indicators were given quite even importance (weights), analysed above. For the ***assets*** domain the ***community infrastructure*** had higher scores compared to ***material style of life*** and ***access to credits***; while for the ***flexibility*** domain, ***to adapt to live without fishing*** had higher score, followed by ***spatial mobility*** and ***livelihood multiplicity***, and lower score was attributed to ***gear***. ***Community Infrustructure*** and to ***adapt to vile without fishing*** have both higher weights and scores, thus contributing more to the overall vulnerability. The scores of indicators are quite even, with ***perceived capacity to change*** and ***level of participation*** with higher values compared to ***recognition of casuality***, for ***agency*** domain; and lower scores were observed for the ***community cohesion*** in Mahielene and for ***linking social capital*** in Farol compared to other indicators. ***Access to information***, ***community Infrustructure***, ***perceived capacity to change***, ***level of participation***, ***adapt to live without fishing*** and ***trust in organizations*** had both, higher weights and scores in almost all communities, thus contributing more to the overall vulnerability index, while ***linking social capital*** had both higher weight and score for Gazene and Mahielene and ***community cohesion*** had both, higher weight and score for Gazene and Farol.

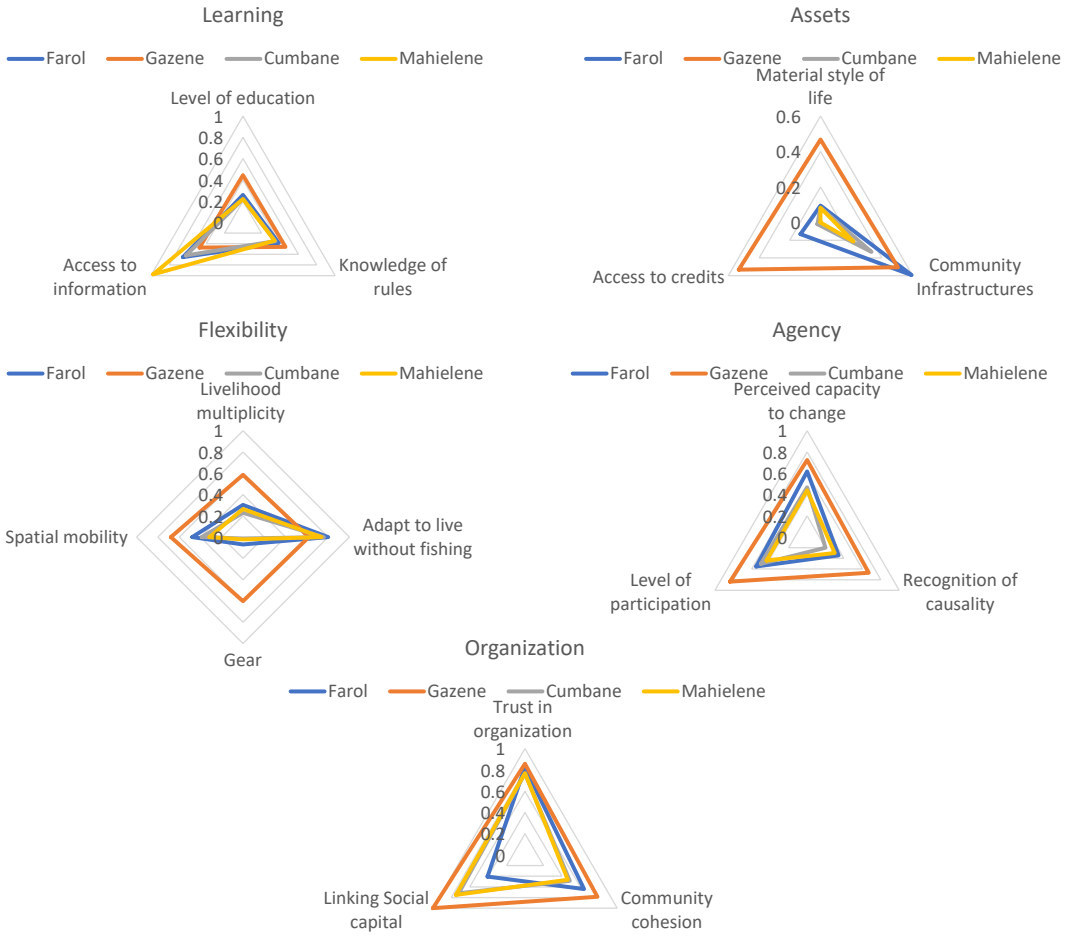


Figure 15. Contribution of indicators scores within the domains of the adaptive capacity dimension.

Other relevant information can be observed from figure 16, is, the livelihood domain significantly influences the climate change vulnerability index (CCVI) in the four studies communities and the second domain influencing the overall CCVI is the learning domain, followed by flexibility, organization, and cultural. In Mahielene, the learning influences significantly the fraction of population studied.

Figure 16. Influence of dimensions domains to the overall climate change vulnerability index.

Finally, the CCVI calculated can vary between (-1 to 1). Negative value of CCVI, means that the sensitivity is higher than the adaptive capacity and positive value of CCVI means that the adaptive capacity is higher than the sensitivity. Communities with negative values of CCVI should be given priority when implementing the climate change adaptation actions. The values of CCVI for the studied communities are, -0.079 for Gazene, -0.042 for Cumbane -0.035 for Farol and 0.187 for Mahielene.

It is also possible to intercompare between the households themselves as shown in figure 17, bellow. This figure shows, on the one hand, that households fall under different quadrants and that in some cases households have high sensitivity while having at the same time very low adaptive capacity. This is a reinforcing situation leading to very high vulnerability. On the other hand, there could be households with very low sensitivity but enjoying a very high adaptive capacity. These households are in a very good situation to copy and adapt to climate change and can be a learning case that could be used to extract lessons and experience on how to build resilient communities.

When analysing the distribution of data per community on figure 17, it is notable that low vulnerability index for Gazene is explained by high sensitivity, while the vulnerability of

Cumbane is explained by low adaptive capacity. The slightly better vulnerability Index of Farol is explained by high adaptive capacity, while the low vulnerability of Mahielene is explained by low sensitivity nevertheless, it has low adaptive capacity.

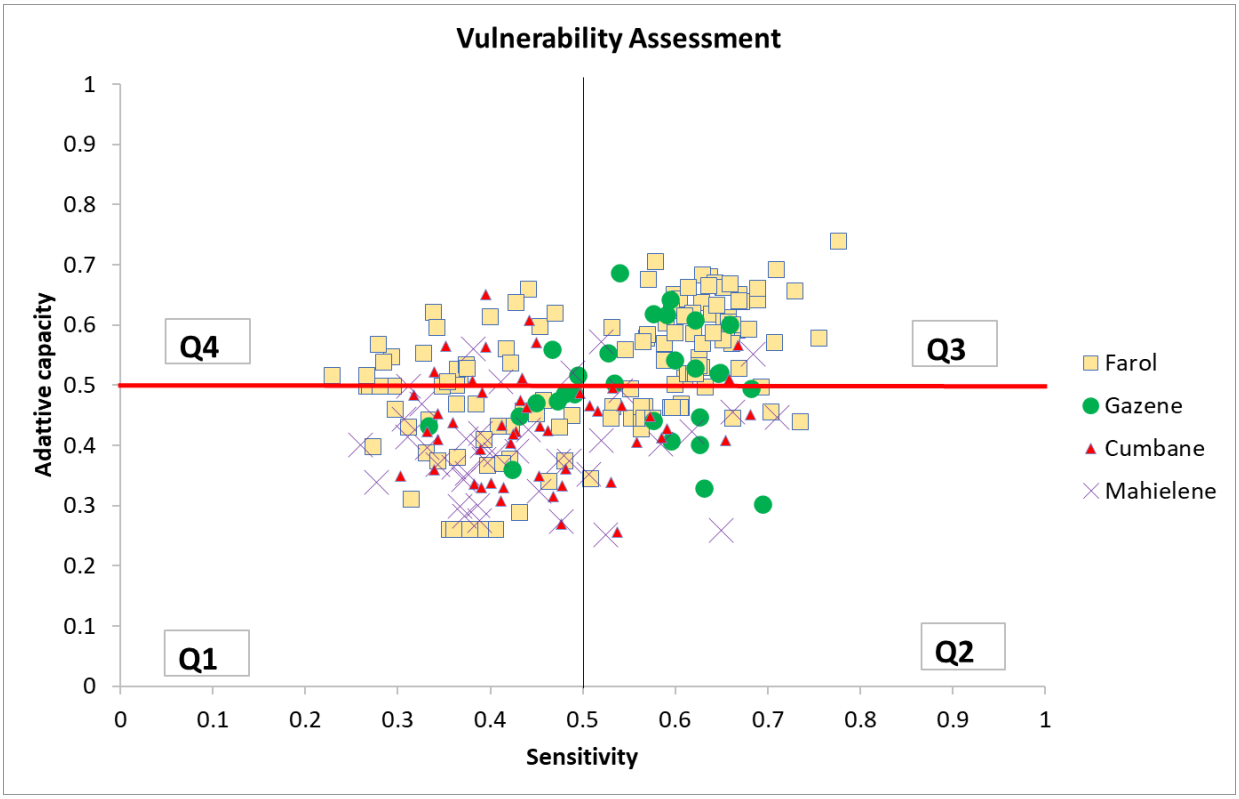


Figure 17. This figure shows complexity in the relation between sensitivity and adaptive capacity within the communities analysis, the two extremes in the upper right and lower right quadrants showing the most promising and the opposite situation for building resilience.

The percentage of households per quadrante of figure 17 was calculated and given in table 3. The Q1 includes households with low sensitivity and adaptive capacity and Q3 includes households with high sensitivity and adaptive capacity. The most vulnerable househlds lay on the second quadrante (Q2), that have high sensitivity and low adaptive capacity, and the least vulnerable households lay on the fouth quadrante (Q4), with low sensitivity and high adaptive capacity. Interesting fact is that, most household lay on the first quadrant (Q1), Cumbane (56%) and Mahielene (62.50%), and and third quadrant, Farol (35.41%) and Gazene (42.86%).
Nevertheless, Gazene present high vulnerability index, together with Farol they may be regarded as good examples because most households have higher adaptive capacity, while, even though Mahielene presents better vulnerability index, together with Cumbane, they can be regarded as

not good examples the contribution of adaptive capacity to the overall vulnerability score is limited.

Table 3: Percentage of household per quadrante

Community	**Q1**	**Q2**	**Q3**	**Q4**
Farol	29.35%	22.83%	**36.41%**	11.41%
Gazene	25.00%	25.00%	**42.86%**	7.14%
Cumbane	**56.00%**	24.00%	4.00%	16.00%
Mahielene	**62.50%**	25.00%	5.00%	7.50%
Overall	**37.75%**	23.51%	27.48%	11.26%

4. Conclusions

The CCVI was calculated for four communities in the two study sites Maputo Bay including Inhaca and Xai-xai including Limpopo Estuarine and the values are: -0.079 for Gazene, -0.042 for Cumbane -0.035 for Farol and 0.187 for Mahielene. In general, the livelihood and learning domain contributes more for the overall CCVI in all studies communities. Gazene is the most vulnerale community among the studied communities followed by Cumbane, Farol and lastly Mahielene.

The sensitivity of communities might be related to the activities that sustain the community, which is mainly fishing for Gazene and agriculture for Cumbane. While for Farol and Mahielene both agriculture and fishing sustain the live of households.

The indicators that contribute more to the overall sensitivity by having both higher weights and scores in almost all communities are: ***employment status***, ***percentage of income from the main activity***, ***appreciation of biodiversity***, ***nutritional dependency***, while the indicators that contribute more to the overall adaptive capacity are ***access to information***, ***community Infrustructure***, ***perceived capacity to change***, ***level of participation***, ***adapt to live without fishing*** and ***trust in organizations*** in almost all communities. Additionaly, adaptive capacity has significant contribution of ***linking social capital***, for Gazene and Mahielene and ***community cohesion*** for Gazene and Farol, by having also both, higher weight and score.

5. Recommendations

The difference of vulnerabilities of the communities studied is not marked, thus all communities have to be considered during the development of adaptation plan. Nevertheless, Gazene should be given more priority, followed by Cumbane, Farol and lastely Mahielene.

To improve the CCVIs, reducing sensitivity and increasing the adaptive capacity, actions that influence the indicators of the livelihood, learning and organization domains should be given priority. This do not mean that actions that are related to other domains should be neglected, particularly because the situation is always dynamic and changes in one variable will surely trigger new reaction in the system. Experience elsewhere suggest that intervention for transformation should be closely monitored to prevent instances of maladaptation and undesirable feedbacks (Thiault, et al., 2021).

Regarding to indicators, for reducing the sensitivity actions should be implemented that target indicators with higher weights (importance) and higher scores, while for adaptive capacity actions should target indicators with higher importance (weights) and lower scores. These indicators are: for sensitivity dimension (***employment status***, ***percentage of income from the main activity***, ***appreciation of biodiversity***, ***nutritional dependency)*** and for adaptive capacity dimension ***(level of education, knowladge of rules, material style of life, access to credits, livelihood multiplicity , gear, recognition of casuality)*** for all communities, including ***linking social capital*** for Farol and ***community cohesion*** for Mahielene.

Based on the explanation of indicators, for reducing the sensitivity of all communities included in the study, actions should be implemented that aim to: (1) increase the employment, (2) the diversification of sources of income in the communities, (3) improve the understanding the value of biodiversity, thus increasing the willingness to participate in actions that protect the ecosystems, and (4) improve the on access to quality food, while to improve the adaptive capacity, actions should implemented that aim to: (1) improving the level of education of local communities, (2) improving the knowledge and recognition of rules aiming preservation of natural resources and ecosystem, such as, rules defining places where people are not supposed to fish, fishing gears, times that people are not supposed to fish, and species of fish that people are not supposed to catch, (3) facilitate people from having assets, (4) facilitate the access to credits, (5) ncrease the number of livelihood options, (6) facilitating access to different gears because it increases the possibility of catching marine resources, thus making the respondents able to adapt in case of changing in the fishing methods caused by reduction of resources availability, (7) recognition of management affecting availability and quality of marine resources thus enabling the communities willingness to participate in the management. For particular case of Farol the taxes paid by communities should

result on better public infrustructures, including streets, hospitals and schools and for Mahielene, people should be motivated to help each other.

The activities aiming to reduce the vulnerability of studied communities should be implemented in line with the priority actions listed in the National Climate Change Adaptation and Mitigation Strategy of Mozambique. Action lines aiming to reduce de sensitivity and increase the adaptive capacity listed above are in line with the following strategic action lines presented in the National Climate Change Adaptation and Mitigation Strategy of Mozambique: 4.6.1.1 Climate Changes Risk Reduction, that include enhancing early warning system, and the capacity and preparedness, to respond to climate changes; 4.6.1.2 Water Resources, that include enhancing the water resources management, as well as, the access, collection, storage, treatment and distribution of water; 4.6.1.3 Agriculture, fisheries, food security and nutrition, that include, Increase the resilience of agriculture, livestock, fishing resilience, as well as ensuring food security and nutrition.

Trades-off and maladaptation

The relationship between various components of socio-ecology system is complex and cannot be fully captured by any climate change vulnerability assessment method (Thiault, et al., 2021). Implementation of adaptation measures based on results of climate changes vulnerability assessment may lead to undesired feedback and unwanted results (Thiault, et al., 2021). Implementation of same actions that aim to improve live standard of local communities, listed above, for example: (1) increase the employment, (2) enhance the diversification of sources of income in the communities (3) improve the on access to quality food, (4) facilitate people from having assets, (5) facilitate the access to credits, (6) increase the number of livelihood options, (7) facilitating access to different gears, may lead to unwanted risks, such as, (1) overconsumption and overexploitation of resources of the ecosystem, thus leading to the system collapse, and (2) establishment of apparently stable community but extremely sensitive to sadden extreme changes, that are inevitable, such as loose of people goods and services during a flood. Other possible unwanted results can be listed, however, these aspects should be carefully addressed for every and single action, planned and/or implemented to improve the adaptive capacity or reduce the sensitivity of studies communities or others.

6. Bibliography

D'agata, S., Darling, E. S., Gurney, G. G., McClanahan, T. R., Muthiga, N. A., Rabearisoa, A., & Maina, J. M. (2020). Multiscale determinants of social adaptive capacity in small-scale fishing communities. *Environmental Science and Policy, 108*, 56 - 66.

Feldmeyer, D., Birkmann, J., McMillan, J. M., Stringer, L., Leal Filho, W., Djalante, R., . . . Liwenga, E. (2021). Global vulnerability hotspots: differences and agreement between international indicator-based assessments. *Climate Change 162:12*.

Gunderson, L. H., & Holling, C. S. (Eds.). (2002). *Panarchy: Understanding Transformations in Human and Natural Systems.* Washington: Island Press.

Gurney, G. G., & Darling, E. S. (2017). *A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management - A Practical Monitoring Handbook.* Southern Blvd: Wildlife Conservation Society.

Gurney, G. G., Darling, E. S., Jupiter, S. D., Mangubhai, S., R, T., Lestari, P., . . . Rossi, N. A. (2019). Implementing a social-ecological systems framework for conservation monitoring: lessons from a multi-country coral reef program. *Biological Conservation*.

Holling, C., Gunderson, L. H., & Ludwig, D. (2002). In Quest of a Theory of Adpative Change. In C. Holling, L. H. Gunderson, Ludwig, L. H. Gunderson, & C. Holling< (Eds.), *Panarchy: Understanding Transformation in Human and Natural Systems* (p. 3 to 62). Washington: Island Press.

Huang, I., Keisler, J., & Linkov, I. (2011). Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. *Science of the Total Environment, 409*(19), 3578–3594.

Khotari, C. (2004). *Research Methodology - Methods and Techniques.* New Delhi: New Age International Publisher .

McNamara, K. E., Clissold, R., Westoby, R., Piggott-McKellar, A. E., Kumar, R., Clarke, T., . . . Nunn, P. D. (2020). An assessment of community-based adaptation initiatives in the Pacific Islands. *Nature and Climate Change, 10*, 628–639. doi:https://doi.org/10.1038/s41558-020-0813-1

Nachmias, F., & Nachmias, D. (2008). *Research methods in the social sciences.* New York: Worth Publishers.

Naing, l., & Winn, T. (2006). Practical Issues in Calculating the Sample Size for Prevalence Studies. *Medical Statistics*, 9-14.

Saaty, T. (1980). *The Analytic Hierarchy Process.* . New York: McGraw Hill.

Thiault, L., Jupiter, S. D., Johnson, J. E., Cinner, J. E., Jarvis, R. M., Heron, S. E., . . . Claudet, J. (2021). Harnessing the potential of vulnerability assessments for managing social-ecological system. *Ecology and Society 26 (2)*.

Tress, Bär, Tress, G., & Fry, G. (2006). Defining concepts and process of knowledge production in integrative research. In Tress, Bär, G. Tress, G. Fry, & P. Opdam (Eds.), *From Landscape Eduacation to Landscape Planning: Aspects of Integration, Education and Application* (pp. 13 - 26). Dordrecht: Springer.

Warmbrod, J. r. (2014). Reporting and Interpreting Scores Derived from Likert-type Scales. *Journal of Agricultural Education*, 30-47.

Appendix 1. Explanation of Domains in the context of the study

Dimension	Domain	Explanation
Sensitivity	Livelihood	Livelihoods encompass elements that are relevant to sustain life of people in the community. For this case, includes employment, fisheries and other marine resources and the time spent by the head of household doing the activity that sustains the family.
	Demographic	Demographic, that encompass gender, percentage of children in the household, years that the family lives in the village and family dependency (explained by percentage of employed people in the household)
	Cultural	This domain includes cultural habits that might influence the sensitivity of the community, encompassing, the (1) appreciation of biodiversity explained by the intention of people to protect the ecological systems; the (2) Identity and pride, that is explained by the feeling of ownership of the land and resources; and (3) Appreciation of lifestyle, that is explained by the feeling of willing to live in the village doing the same activities.
	Health	This domain includes (1) Age of the household leader, (2) Nutritional dependency, measured by access to food and the (3) Sense of place, that determines the sense of being home.
Adaptation capacity	Learning	Learning is explained by the Level of formal education, Knowledge of rules that aim to regulate the exploitation or marine resources in the context of climate change and the Access to information on climate change, early warning system, etc. This knowledge enhances de adaptive capacity of the community.
	Assets	This domain is related to the assets that the village people own, that encompass, the Material style of life (accessories owned by the households); Community Infrastructures, that include hospitals, schools and coastal protection infrastructures, and the Access to credits that determine the ability of the community to adapt to climate changes.
	Flexibility	Flexibility is related to the ability of communities to adapt to changes caused by climate changes. In this case, it includes, the Livelihood multiplicity, ability to adapt to live without fishing, usage of different Gears and Spatial mobility.
	Agency	Agency includes in this case the (1) Perceived capacity to change, explained by the feeling about leaving the village, (2) Recognition of causality, management affecting availability and quality of marine resources and (3) Level of participation, measured by the involvement of the community in different aspects of marine resources management.
	Organization	The organization is related to (1) Trust in organization, measured by the community trust on the organizations; (2) Community cohesion, measured by the availability to help each other; and (3) Linking Social capital measured by the Information on the taxes paid ensure that the community argue for the intended support.

Appendix 2 - Indicators including explanation, data collection methods and scoring – Mozambique

Dimension	Domain	Indicator	Method	Explanation	Scoring method
Sensitivity	Livelihood	Employment Status	Q9	This is the employment of the family leader, If the employment is sensitive to climate change, this indicator should be considered zero	Unemployed =1 Employed in a climate sensitive job = 1 Employed = 0
		Percentage of catch from fishing sold	Q26	This indicator measures the ability of local communities of getting money from fisheries and how much are they dependent on the marine resources?	Percentage of fish sold.
		Percentage of income from the main activity	Q14a	If the income of people comes from the same source it becomes more sensitive	Percentage of income from activity scored as (1), main activity.
		Time conducting the activity	Q15a	The family becomes more sensitive if they depend on marine vulnerable resources and they develop only the	Less than one year = 1, less sensitive 1-5 years =2 5-10 years =3

Dimension	Domain	Indicator	Method	Explanation	Scoring method
				same activity for a long time	10-20 years =4 20-30 years =5 More than 30 years = 6, highly sensitive
	Demographic	Gender	Q3	The gender of family leader. The female leaded families are considered sensitive	Female =1 Male = 0
		Years Living In the village	Q7	The time spent in the village might limits the willingness to move to another place, if necessary, thus making them more sensitive to climate change.	Less than one year = 1, less sensitive 1-5 years =2 5-10 years =3 10-20 years =4 20-30 years =5 More than 30 years = 6, highly sensitive
		Percentage of children in the family members	Q8	If the percentage of children is higher the family becomes more sensible. Children,	Fraction of children in the family

Dimension	Domain	Indicator	Method	Explanation	Scoring method
				considering age below 18 years	
		Family dependency	Q12a and Q8	This indicator evaluates the ability to sustain the family if one family member becomes unavailable	Percentage of household members employed
	Cultural	Appreciation of biodiversity	Q77 and Q78a	Understanding and appreciation of biodiversity, including associated cultural habits might reduce the sensitivity of the ecosystem and community by increasing the willingness to participate in the protection of the ecosystems.	Standardized average of Q78 and Q79aI don't understand the question = 5, highly sensitive. My actions have significant effect on biodiversity = 1, low sensitivity Yes = 0, low sensitivity. No = 1, highly sensitive;
		Identity and pride	Q78b	Feeling pride of the land and resources increase the willingness to participate in the protection of	Yes = 0, low sensitivity. No = 1, highly sensitive;

Dimension	Domain	Indicator	Method	Explanation	Scoring method
				ecosystem and climate change adaptation actions	
		Appreciation of lifestyle	Q79	When the villagers appreciate their lifestyle, they are most likely to participate in actions to protect the environment and adaptation actions	Very bad = 5, highly sensitive Vary good = 0, low sensitivity
	Health	Age	Q1	The age to be considered here, is the age of family leader. If the respondent is the family leader representative, the age of family leader should be the one to be registered.	Below 20 and above 65 = 1 highly sensitive. Between 20 and 65 = 0, less sensitive
		Nutritional dependency	Q40, Q41, Q42 and Q43	Nutritional dependency is evaluated based on access to food	For questions Q40, Q41 and =Q42. Yes =1, highly sensitive and No = 0, not sensitive. For Q43, once = 5, highly sensitive

Dimension	Domain	Indicator	Method	Explanation	Scoring method
					and Over 3 times = 4 not sensitive. The results of the questions are combined using the sum of standardized values, varying from 0-1
		Sense of place	Q7	The time spent in the village gives the person a sense of home, and this makes difficult to move to another place, when required. This effect is comparable with special mobility	Less than one year = 1, less sensitive 1-5 years =2 5-10 years =3 10-20 years =4 20-30 years =5 More than 30 years = 6, highly sensitive
Adaptation capacity	Learning	Level of education	Q3	The education to be considered is the family leader's. Highly educated family leader have high adaptive capacity.	[1] Class 8 or less [2] Secondary school - level certificate [3] A-level certificate[4] Tertiary [5]

Dimension	Domain	Indicator	Method	Explanation	Scoring method
					University and above
		Knowledge of rules	Q32	This indicator evaluates if there rules regarding and if this rules are known (1) Places where people are not supposed to fish, (2) Certain fishing gears that people are not supposed to use, (3) Certain times that people are not supposed to fish, (4) Certain species or types of fish that people are not supposed to catch. If the rules are either not established or know, this will result on low adaptive capacity	The score is calculated as average of the scores to items listed in the explanation. For each item, if the No one = 5, knowledge and implementation of rule, high adaptive capacity; and Don't know = 1, not knowing the rules, even if there are available, low adaptive capacity.
		Access to information	Q68 Q70 and Q73a	Access to information on climate change, adaptation measures and early warning increases the adaptive	As standardized average of scores of questions Q68 Q70 and Q73a. For Q68

Dimension	Domain	Indicator	Method	Explanation	Scoring method
				capacity of the community	Yes = 1, high adaptive capacity No = 1 Low adaptive capacity For Q70 and 73a (Not worried and Very limited) = 1, low adaptive capacity (Very and Very good) = 5, high adaptive capacity
	Assets	Material style of life	Q45	Having the assets means high adaptive capacity and not having means low adaptive capacity	Yes = 1, high adaptive capacity No = 0, low adaptive capacity
		Community Infrastructures	D46c	The community infrastructures such as hospitals, schools and coastal protection infrastructures determine high adaptive capacity	Very good = 5, high adaptive capacity Very bad = 1, low adaptive capacity

Dimension	Domain	Indicator	Method	Explanation	Scoring method
		Access to credits	Q51	Access to credits reveals high adaptive capacity	No =0, low adaptive capacity Yes = 1, high adaptive capacity
	Flexibility	Livelihood multiplicity	Q17	The respondent selects the livelihood options within the list in the Household questionnaire. High number of options indicates high adaptive capacity	Number of livelihood options selected by total number of livelihood options
		Adapt to live without fishing	Q19	This indicator evaluates the ability to leave if fishing in the area becomes unsustainable activity. This indicator is relevant for Mozambique as coastal country where there are people depending greatly on fishing.	Average score from 1 to 5, given by respondents divided by 5. Where extremely sensitive is Strongly disagree = 1 and Strongly agree =5 to the statement "I could easily stop fishing,

Dimension	Domain	Indicator	Method	Explanation	Scoring method
					and make my living on land"
		Gear	Q22	This evaluates the possibility of catching marine resources, thus making the respondents able to adapt in case of changing in the fishing methods caused by reduction of resources availability.	Gear options used by total number of gear options
		Spatial mobility	49	By responding the question "Supposing that for some reason you were moving away from your current village, how would you feel about leaving?" reveal the willingness to move if required to leave in other area.	Very bad = 1, low adaptive capacity Very happy = 5, high adaptive capacity
	Agency	Perceived capacity to change	Q49	By responding the question "Supposing that for some reason you	Very bad = 1, low adaptive capacity

Dimension	Domain	Indicator	Method	Explanation	Scoring method
				were moving away from your current village, how would you feel about leaving?" reveal the willingness to move if required to leave in other area.	Very happy = 5, high adaptive capacity
		Recognition of causality	Q60 to Q63	Recognition of management affecting availability and quality of marine resources represents high adaptive capacity because enables the community on willing to participate in the management.	Average of scores given to each question (Much worse, A lot less, Much harder or A lot less reliable) = 1, low adaptive capacity (Much better, A lot more, Much easier, A lot more reliable) = 5, high adaptive capacity
		Level of participation	Q64a), Q64b), Q65, Q66	This indicator measures the involvement of the community in different aspects of	For Q64a, 64b and 65 (Not at all and Not involved,) =1, low

Dimension	Domain	Indicator	Method	Explanation	Scoring method
			and Q67	marine resources management.	adaptive capacity (Very often and Highly involved (in leadership)) = 4, high adaptive capacity For Q65 (Strongly disagree) = 1, low adaptive capacity Strongly agree = 5, high adaptive capacity For Q66 and 67 (Very unfair, Daily and Don't know) = 1, low adaptive capacity (Very fair, No conflict) = 5 high adaptive capacity

Dimension	Domain	Indicator	Method	Explanation	Scoring method
	Organization	Trust in organization	Q31	This indicator measures how much the community trust on the organizations, that include, other people in the village, village leaders, marine resources management, NGOs and government	This is calculated as the average trust in the items listed in the explanation of the indicator. For each item, Not at all = 1, showing non trust on the organizations, low adaptive capacity; and Trust all = 5, showing trust on the organizations, high adaptive capacity
		Community cohesion	Q33	The availability to help each other in every circumstance demonstrated social cohesion and higher adaptive capacity	Yes = 1, demonstrates high community cohesion and high adaptive capacity and No = 0, demonstrating low social cohesion. low

Dimension	Domain	Indicator	Method	Explanation	Scoring method
					adaptive capacity
		Linking Social capital	Q74, 75 and 76	Information on the taxes paid ensure that the community argue for the intended support from the government. Well structured, taxes can be used to build adaptive capacity	Yes = 1, high adaptive capacity No = 0, low adaptive capacity

Appendix 3 Key Informants Questionnaire

Targeted Key Informants: Fisheries officials, Beach management unit leaders, Head of villages, Community development officials, Community based organization, Planners, NGOs

1. Location

1.1 Name of the Interviewee:

1.2 Occupation:

1.3 Name of Region:

1.4 Name of District:

1.5 Name of Ward:

1.6 Age: Contact:

1.7 What types of marine ecosystems are present in the sites: Mangroves, Coral reefs, Seagrass beds? If the interviewee has a Land use or seascape map with villages on it, discuss about the locations of the ecosystems. If not, prepare and bring a map and point out the ecosystems locations.

2. **Exposure**

2.1 Have communities in the site experienced changes in climate? And how the current climate is different from that of 20-30 years ago?

2.2 Explain on how the following parameters affected your livelihood activities; - Precipitation change, sea level change, water temperature change, change in wind, air temperature change, humidity change, ocean acidification, ocean current change, extreme temperature frequency, drought frequency, storm surge and extreme marine heat events

2.3 What are the main climate parameters that have the most impact on fish communities?

3. Sensitivity

3.1 Livelihood

3.1.1 What are the impacts of climate change on coastal and marine resources? How have they been affected?

3.1.2 What are the impacts of climate change on the community livelihoods?

3.1.3 Where do you or coastal community in your area depend on for survival between land or coastal and marine based livelihood? Why?

3.1.4 To what extent do you or coastal community in the site rely on coastal and marine resources for survival?

3.2 Cultural

3.2.1 Are there any important cultural, traditional or spiritual practices associated with the sea

3.2.2 What are the cultural benefits from coastal and marine resources that local communities enjoy? Have these cultural benefits affected by climate change? How?

3.3 Health

3.3.1 What are the impacts of climate change on local community's health? Food and waterborned Diarrheal Disease, Air Pollution, Food security (Length of the lean season), mental health and stress-related disorders.

4. Adaptive capacity

4.1 Flexibility

4.1.1 Business size /Frequency of fishing in the community (Difference from a reference time) [Livelihood multiplicity]

4.1.2 Time spent in the sea (Difference from a reference time) [Spatial mobility]

4.1.3 Fishing distance from the shore (Difference from a reference time) [Spatial mobility]

4.1.4 Gear diversity

4.1.5 What are the main sources of income? (1) Fishing (2) Commerce (3) Agriculture (4)Workers (For another households) (5) Other

4.2 Organization

4.2.1 Are there migrant fishers in the site? Have they settled permanently or temporarily? What period of the year do they fish and where?

4.2.2 How many different ethnic groups are there in the site?

4.2.3 Are there conflicts/problems about marine resources here? If conflict happens, (b) who is involved? (c) What is the conflict about? (d) What is the intensity? (e) What is the frequency? (f) How is the conflict resolved? [Community cohesion]

4.3 Assets

4.3.1 When were there interventions by government, NGOs, projects or individuals from outside the village (e.g. nurseries, environmental awareness, infrastructure, school, running water, hospital)? [Community infrastructures]

4.3.2 Do the sites have access to credit? What is the percentage of households that have access to credit? [Access to credits]

4.4 Learning

4.4.1 How do communities have access to information: Radio, Mobile… [Access to information]

4.5 Governance (will be added to Organization)

4.5.1 How is the site managed? Community based? Government based? NGOs?

4.5.2 What types of activities have you [the interviewee] been involved in?

4.5.3 What tools have you used? How effective were these tools in reaching and motivating Fishers?

4.5.4 Who have your efforts been focused on?

4.5.5 Who have you collaborated with?

4.5.6 What are the sources of weather and climate information in the site?

4.5.7 Do people break rules?

- Places where people are not supposed to fish

- Certain fishing gears that people are not supposed to use
- Certain times that people are not supposed to fish
- Certain species or types of fish
- that people are not supposed to catch

5. Fieldwork: Village selection

Based on these data, to which villages would you think we should conduct household surveys to get representative data of the site?

Do you have any contacts or key informants that we should talk to in the site/selected villages

Appendix 4 Household Survey

CLIMATE CHANGE VULNERABILITY ASSESSMENTS IN SELECTED COASTAL COMMUNITIES IN MOZAMBIQUE

QUESTIONNAIRE

Study site: _____ County/District: _____

Village: _____ Date: _____

Survey no.: _____ Name of interviewer: _____

Latitude/longitude: _____

PART 1: SENSITY DIMENSION

Demographic Characteristics *(Please tick one)*

1) Age (in years): ……
2) Sex:

   [1] Female [2] Male [3] Other
3) Formal education:

   [1] Class 8 or less [2] Secondary school - level certificate [3] A-level certificate

   [4] Tertiary [5] University and above
4) What is your religion?

   [1] Muslim [2] Christian [3] Hindu

   [4] Traditional [5] Other (specify) ……
5) Marital status: [1] Single [2] Married [3] Married before [4] Other
6) Where are you originally from? (*Tick only one option below)*
   [1] This village [2] Another village in this county [3] Coastal area other than this location [4] This country (not coastal area) [5] Another country
7) How many years have you lived in this village? .....
8) How many people are currently in your household, including yourself? *(Please write down the number of people below each category)*

Adult male	Adult female	Male children	Female children

9) What is your employment status? [1] Unemployed [2] Employed

10) If employed, what form of employment are you engaged in?

---

11) If unemployed, is anyone from your household engaged in formal employment?

[1] No [2] Yes

12) Please give details of employment for any members of your household who are employed (specify type of occupation) _____

_____

12a How many family members are employed? _____

13) If unemployed, how do you earn income or obtain food and other necessities?

_____

14) How much income do you earn per week/month/year? Mts. _____

14a List the main sources of income to the family and score than in order of priority and include de average amount per activity.

Activity	Priority	Average income
Total		

15) If fisher, what marine resources do you depend on? Mts. _____

15a How long you have been developing the activity that is the main source of income?

_____

PART 2: SOCIAL ADAPTIVE CAPACITY DIMENSION

FLEXIBILITY

Livelihood multiplicity

16) Traditional uses of marine resources

i. What goods did you obtain from the marine resources in the past?

ii. Have these goods changed over time? [1] No [2] Yes

iii. If yes, how?

iv. How else did you benefit from the marine resources in the past? *(probe for ecological services)*

v. Has the benefits changed over time? [1] No [2] Yes

vi. If yes, how?

a) How do you use marine resources now?

i. What goods do you obtain from the marine resources now?

ii. How else do you benefit from the marine resources now? *(probe for ecological services)*

17) What economic activities do you engage in to obtain food or income to your house? What do other people in your house do that brings in food or money to your house?

Livelihood activity	**Tick livelihoods of the respondent**	**Number of people in the household involved in activity**		**Rank the economic activities in order of importance**
		Women	**Men**	
Fishing				
Gleaning				
Medium scale fish trade/fish dealer				
Fish mongers (*mama karanga*)				
Mangrove cutting or trade				
Agent (middleman)				
Aquaculture/Mariculture				

Hunting				
Farming (cash crops)				
Farming (peasant/subsistence, livestock)				
Salaried employment (e.g. teacher, nurse)				
Tourism and handicrafts				
Small business(not marine related)				
Other:				
Other:				

18) Is fishing your primary livelihood? [1] No [2] Yes

19) If yes, how much do you agree with this statement? *(Please circle **one** option):*

"I could easily stop fishing, and make my living on land"

Strongly disagree	Somewhat disagree	Neither	Somewhat agree	Strongly agree

20) Cultural/heritage impacts

a) What areas of the marine environment/resources are of special interest to communities for cultural or religious purposes?

b) Has this changed over time? [1] No [2] Yes

c) If yes, how? _____

Fishing and Marine Resources Management/Gear diversity

21) Do you own a boat? (Tick as appropriate)

[1] No boat
[2] Boat without a motor (e.g., canoe)
[3] Boat with a motorized engine (engine has__hp)
[4] Other(specify)__

22) Which fishing gears does your household use? *(Tick appropriately)*

Gear	Tick gear used	Gear	Tick gear used
Hand line (inshore/reef)		Purse seine net	

Hand line (offshore/blue water)		Hand spear	
Multiple hooks (more than 20)		Spear-gun	
Trolling line		Fish trap	
Mesh gillnet, above5cm(2inches)		Explosives/Poison	
Mesh gillnet, below5cm(2inches)		Gleaning	
Mosquito nets		Other(specify):	
Small/beach seine net (nets dragged along substrate)		Other(specify):	

23) Which fishing gear is the most important to your household?_____

_____

24) Where is your fishing ground? _____

25) Catch, fishing effort and catch value:

Parameter	**Details**
Quantity of fish & other seafood landed (Kgs/ Bundles/pieces)	
Number of fishing crew	
Number of hours (fishing and travelling)	
Total value of catch (local currency)	

26) Typically, what percentage of your catch from fishing or gleaning do you sell, retain for own consumption or give away?

Retain for own consumption ____% sell ____% give away____% don't know ____%

27) If you were to get 50% less catch all year what would you do? (*Tick **multiple boxes** if necessary*)

Keep fishing at same	Fish more often	Change fishing grounds	Change fishing gears	Fish less & switch to other	Stop fishing entirely

amount				livelihood	
Other(specify):					

28) In general, how often do you and your household eat locally caught fish or other sea food that was caught by you or someone in your community? (*Please circle **one** option*)

More than once per day	Once per day	More than once per week	Once per week	More than once per month

29) Over the past 5 years, has the number of fish caught around your area changed? If so, how has it changed? *(Tick **one** option)*

[1] Significant decrease [2] Decrease [3] No change

[4] Increase [5] Significant increase

30) What can be done to increase availability of fish in the sea around here?_____

_____

ORGANIZATION

31) In general, how much do you trust the following people? (*Tick **one** option for each group).*

	Not at all	Distrust more people than trust	About half-half	Trust more people than distrust	Trust all
People in your village					
Village leaders					
Marine resource management group					
NGOs					
Government					

32) I am interested in learning about some of the rules and traditions about fishing here.

(A) Are there places where people are not supposed to fish, nor use certain gears, etc.?

(B) Who created the rules? (**C**) Do people still fish there? If so, how many people?

*(Interviewer: please **fill out first row** before moving to next row, i.e. ask A-C for places where people are not supposed to fish followed by A-C for fishing gears that people are not supposed to use).*

Rule	**Description of rules, e.g. what gears are not used etc.**	**Who created the rules?** *(tick multiple boxes if necessary)*	**Do people still fish there? If so, how many?** *(tick one box)*
Places where people are not supposed to fish		☐ Fishers/local users ☐ NGO ☐ Government ☐ Other:_____ ☐ Don't know	☐ No one ☐ A few ☐ About half ☐ Most ☐ Everyone ☐ Don't know
Certain **fishing gears** that people are not supposed to use		☐ Fishers/local users ☐ NGO ☐ Government ☐ Other:_____ ☐ Don't know	☐ No one ☐ A few ☐ About half ☐ Most ☐ Everyone ☐ Don't know
Certain **times** that people are not supposed to fish		☐ Fishers/local users ☐ NGO ☐ Government ☐ Other:_____ ☐ Don't know	☐ No one ☐ A few ☐ About half ☐ Most ☐ Everyone ☐ Don't know
Certain **species or types of fish** that people are not supposed to catch		☐ Fishers/local users ☐ NGO ☐ Government ☐ Other:_____ ☐ Don't know	☐ No one ☐ A few ☐ About half ☐ Most ☐ Everyone ☐ Don't know

Other, please describe:		☐ Fishers/local users ☐ NGO ☐ Government ☐ Other:_____ ☐ Don't know	☐ No one ☐ A few ☐ About half ☐ Most ☐ Everyone ☐ Don't know

Social Capital

33) Social networks

a) Are there times when you go to someone else for help? [1] No [2] Yes

b) If the answer to question a) is yes, who do you run to for help in times of need? __

_____

c) Why do you run to this person(s) and not any other person(s)? _____

d) Who are the key decision makers in the community? _____

e) How are decisions made in the community? _____

Learning

34) Local perception of marine resources management and management success

a. In your opinion, are the marine resources managed well? _____

b. What aspects of management do you consider successful in your area? _____

_____

f) Is there effective enforcement of rules and regulations governing marine resources? [1] No [2] Yes

If yes, explain: _____

c. Are the local communities involved in marine resources management?

[1] No [2] Yes

If yes, how? _____

d. What is your opinion regarding marine resources conservation? _____

35) Level of understanding of human impacts on marine resources

a. Are there any activities that damage marine resources in the area? _____

b. Are you concerned about sustainability of the marine resources? _____

36) Distance from village to the sea; importance of markets; slope _____

37) Distance from village to nearest market _____

38) How is cultural knowledge passed down by the community from one generation to another? _____

39) Is there any cultural memory, traditions, and assets that relate to coastal and marine resources that have been handed over to you? _____

_____

Food Security and Wellbeing

40) Were there any moments in the last month when your home did not have enough to eat?
[1] No [2] Yes [3] I don't know

41) Was this unusual?
[1] No [2] Yes [3] I don't know

42) In the past year, have there been times when you feared that your food would not last until you were able to get more?
[1] No [2] Yes [3] I don't know

43) In general, how many times do you eat in the day?
[1] Once [2] 2 times [3] 3 times [4] Over 3 times

44) Since yesterday, can you tell me about the meals you have prepared for your family?

ASSETS AND ACCESS TO CREDIT

Material Style of Life

45) Material style of life and owned assets. *Please **tick all the household items or facilities p**resent in the household. Also **record the number of each asset** owned by the household.*

Cooking pots [1] No [2] Yes How many:	**Radios/cassette/CD** [1] No [2] Yes How many:	**DVD/VCD players** [1] No [2] Yes How many:
Mattresses [1] No [2] Yes How many:	**Mobile phone** (not smart phone) [1] No [2] Yes How many:	**Smart phone sortables** [1] No [2] Yes How many:

Flushing toilet [1] No [2] Yes How many:		**Indoor piped water (tap)** [1] No [2] Yes How many:	
Washing machine [1] No [2] Yes How many:	**Computers** [1] No [2] Yes How many:	**Electric refrigerators or freezers** [1] No [2] Yes How many:	
Cattle/Goats/Pigs /Sheep(livestock) [1] No [2] Yes How many:	**Televisions** [1] No [2] Yes How many:	**Satellite dishes** [1] No [2] Yes How many:	
Private toilet [1] No [2] Yes How many:	**Other1** [1] No [2] Yes How many:	**Other2** [1] No [2] Yes How many:	
Roof Material □ Bamboo/Thatch □ Wood □ Metal □ Tile □ Other:_____	**Wall Material** □ Bamboo/Thatch □ Wood □ Metal □ Cement □ Other:__	**Floor Material** □ Dirt/Soil □ Wood □ Concrete □ Tile □ Other:_____	**Electricity** □ Solar □ Generator □ Grid □ None □ Other:

46) Community infrastructure

a) How are the communities governed?

b) How do the communities relate with higher levels of government?

c) How do you classify the quality of community infrastructures, hospitals, schools, coastal protection infrastructures, etc ?

Very bad	bad	Neither good nor bad	Good	Very good

47) It would be great to know more about how you feel about your life here. All things considered, has your satisfaction with your life as a whole changed over the last three years? [1] No [2] Yes.

If so, how has it changed? *(Please tick **one** option)*

Much worse	Worse	No change	Better	Much better

48) *If there was a change*, what are the three main causes of this change?

1._____

2._____

3._____

49) Supposing that for some reason you were moving away from your current village, how would you feel about leaving?

Very sad	Sad	Neither happy nor sad	Happy	Very happy

50) Do you have access to savings to respond to extreme climatic events? [1] No [2] Yes

51) Do you have access to credit facilities? [1] No [2] Yes; Explain _____

52) For people dependent on marine resources, do you have access to markets?

[1] No [2] Yes

53) Do both men and women have equal access to resources? [1] No [2] Yes

54) Are there any barriers restricting access to the coastal and marine resources? Explain

55) Is government investing in longer term adaptation options? [1] No [2] Yes,

If yes, how? _____

AGENCY

Recognition of causality

56) Does fisheries and mangrove management affect this community? [1] No [2] Yes

57) Does fisheries and mangrove management affect you? [1] No [2] Yes

58) If yes, what are the positive impacts of fisheries and mangrove management for you?

_____

59) What are the negative impacts of fisheries management on you? _____

_____

60) In general, do you think management has affected fish stocks? If yes, how has the fish stock been affected? *(Please tick **one** option)*

Much worse	Worse	No change	Better	Much better

61) In general, do you think management has affected the quality (e.g., size) of fish and other sea food landed?

*(Please tick **one** option)*

A lot less	Somewhat less	No change	Somewhat more	A lot more

62) In general, do you think management has made it easier or harder to catch fish and other sea food (in terms of time, effort, or travel distance)? (*Please tick **one** option*)

Much harder	Hard	Neither	Easier	Much easier

63) In general, do you think management has affected the reliability of what you can catch?

If yes, how has it changed the reliability? (*Please tick **one** option*)

A lot less reliable	Less reliable	No change	More reliable	A lot more reliable

Level of participation

64) Currently, are you involved in the following aspects of marine resources management?

a) decisions about marine resource use (attending meetings about marine resources)

Not at all	Seldom	Never	Often	Very often

b) management of marine resources

Not involved	Involved a little	Never	Involved	Highly involved (in leadership)

65) How much do you agree or disagree with this statement: *(Please tick **one** option)*

"People like me have influence on the management of marine resources."

Strongly disagree	Disagree	Neither	Agree	Strongly agree

66) In general, do you think the way that decisions are made about marine resource use and management are fair? *(Please circle **one** option)*

Very unfair	Unfair	Neither	Fair	Very fair	Don't know

Why? _____

67) Is there any conflict over marine resources here? If yes, how often does this conflict occur? *(Please circle **one** option)*

No conflict	Less than once per year	More than once per year	Monthly	Weekly	Daily	Don't know

CLIMATE CHANGE

68) Have you heard of climate change or global warming?

[1] No [2] Yes

69) Can you tell me what it is? *Please check all the answers the respondent provides. Do not prompt the respondent*

☐ Drought – not enough rain ☐More storms & extreme weather
☐ Floods – too enough rain ☐Increased disease
☐ Sea level rise ☐Impact on fish catch
☐ Warmer conditions
☐Other

70) Are you worried about this affecting your family?

[1] Not worried [2] A little worried [3] Not sure [4] Worried [5] Very worried

71) What traditional knowledge or practices relevant to addressing climate are available in the communities? _____

72) What adaptation options are available to you and the local communities? _____

_____

73) Do you and other members of the community have access to relevant information, such as forecasts or early warming? _____

a) How do you classify it?

[1] Very limited [2] limited [3] Not bad [4] Good [5] Very good

ADITIONAL QUESTIONS

Linking Social capital

74) Do you pay taxes?

[1] No [2] Yes

75) Are you informed about the taxes paid?

[1] No [2] Yes

76) Do you have support from the government to sustain the development of your activities based on the taxes paid?

[1] No [2] Yes

a) Describe, what kind of support do you receive?

Appreciation of biodiversity

77) Do you think that it is important that people participate in biodiversity preservation? Do you think that the daily activities of local people might impact on biodiversity.

I don't understand the question	My actions do not have effect on the biodiversity	My actions do have limited effect on the biodiversity	My actions have effect on biodiversity	My actions have significant effect on biodiversity

78) Do you have traditions that regulate the fishing and exploitation of costal resources?

[1] No [2] Yes

a) Describe, these traditions?_____
_____.

b) How do you feel about your village, environment and marine resources? Are you willing to protect them as your home land and culture?
[1] No [2] Yes

79) How much you like you lifestyle in the village?

Very bad	Bad	Not bad but not good	Good	Very good

SUPLLEMENTARY QUESTIONS - Adaptation to Covid-19

80) How has COVID-19 impacted how you and your family obtain food and income compared to how you normally would at this time of year?

81) Have you and your family made any changes to cope with these impacts? [1] No [2] Yes

82) If the answer to question 74 is yes, please explain _____

_____

83) Has COVID-19 changed the quantity of fish or other sea food that much you have been catching compared to how you would normally catch at this time of year?
[1] No [2] Yes
If yes, how?

Much worse	Worse	No change	Better	Much better

84) Has COVID-19 impacted the fish market? [1] No [2] Yes

Please explain _____

85) Are people in the community able to access markets? [1] No [2] Yes

Please explain _____

86) Have you and your family made any changes to cope with these impacts? Please tell me about them.

87) Has COVID-19 changed the price of fish now compared to this time of year normally?

How?

Has COVID-19 affected the types and variety of food you and your family are eating now, compared to normally at this time of year? [1] No [2] Yes
If yes, how? _____

88) Are there foods you normally eat at this time of year that you are not able to eat at the moment? [1] No [2] Yes

If yes, why?

89) Have you and your family made any changes to cope with these impacts? Please tell me about them.

90) What impacts has COVID-19 had on livelihoods in the community?

_____

_____

_____.

91) Has the number of people who are engaged in fishing changed? [1] No [2] Yes
If yes, how? _____

92) Has the intensity of fishing changed? [1] No [2] Yes
If yes, how? _____

93) How has the community responded to COVID-19? _____

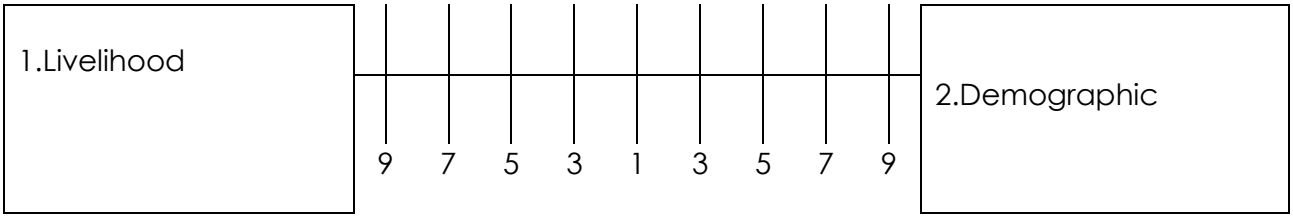
Appendix 5 Questionnaire for determination of relative weights of domains and indicators using the AHP method

We are carrying out research, in the context of development of CCVA for the coastal areas of Mozambique. Through this survey, it is intended to determine the relative weights to be attributed to the different domains and to each of the indicators that make up the groups. The methodological explanation is given in an accompanying document, you can also interact with the researchers involved for any clarification on the filling procedures. The survey is completely anonymous.

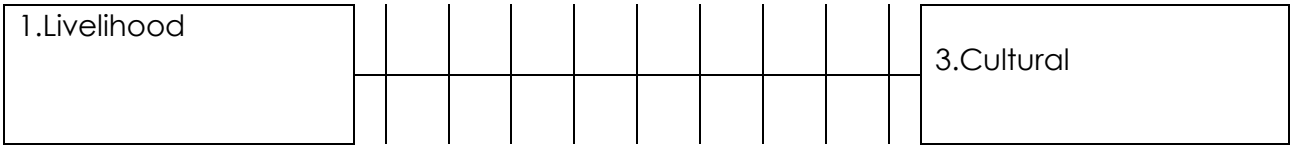
I. Sensitivity

a) Domains

1 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the livelihood or demographic aspects? To what degree you think your choice is important.

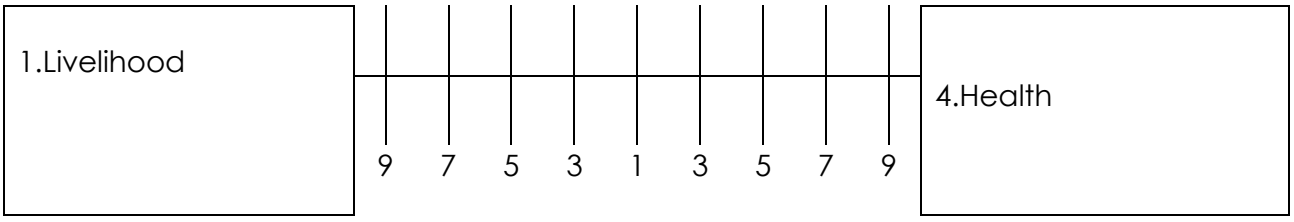


2 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the livelihood and economic dependence on the resource or the Cultural aspects? To what degree you think your choice is important.

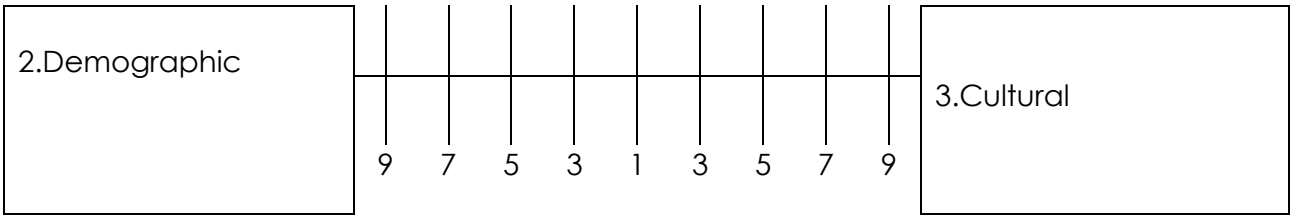


	9 7 5 3 1 3 5 7 9	

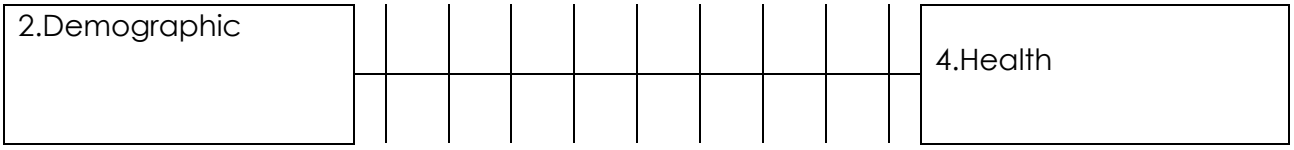
3 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the Livelihood or the Health issues? To what degree you think your choice is important.



4 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the Demographic aspects or the Cultural aspects? To what degree you think your choice is important.

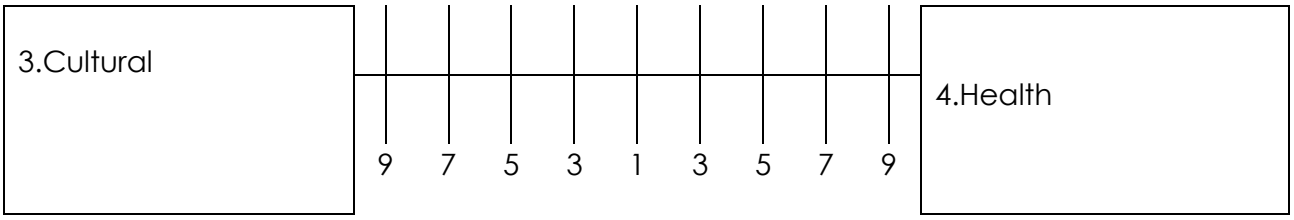


5 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the Demographic aspects or the health? To what degree you think your choice is important.



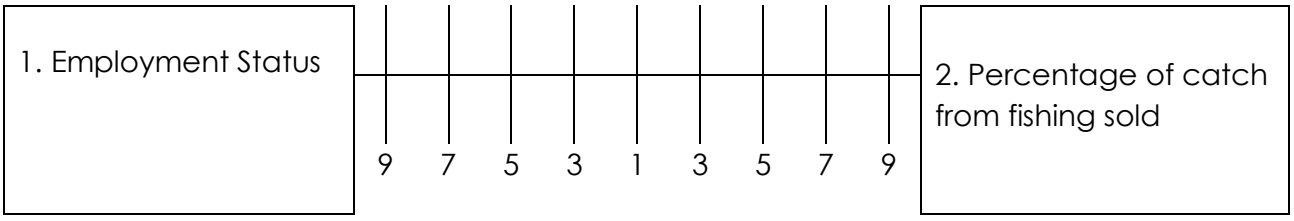
	9	7	5	3	1	3	5	7	9	

6 There are different aspects that determine the sensitivity of coastal area communities. In your opinion what is more important in determining the sensitivity to climate change for the communities in the southern part of Mozambique, the Cultural aspects or the Health aspects? To what degree you think your choice is important.



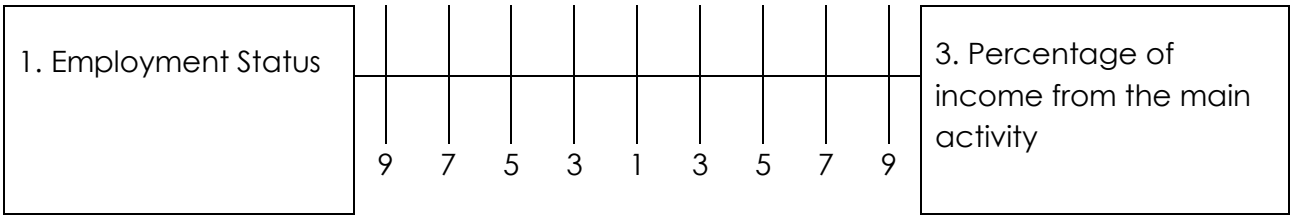
b) Livelihood/Economic dependence

7 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Employment Status or the Percentage of catch from fishing sold? To what degree you think your choice is important.

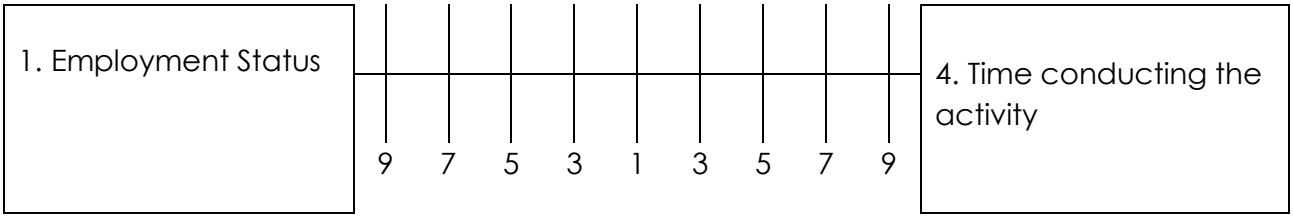


8 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Employment Status or

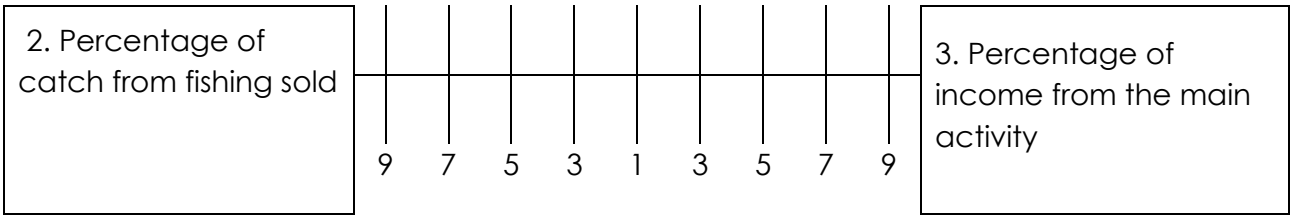
the Percentage of income from the main activity? To what degree you think your choice is important.



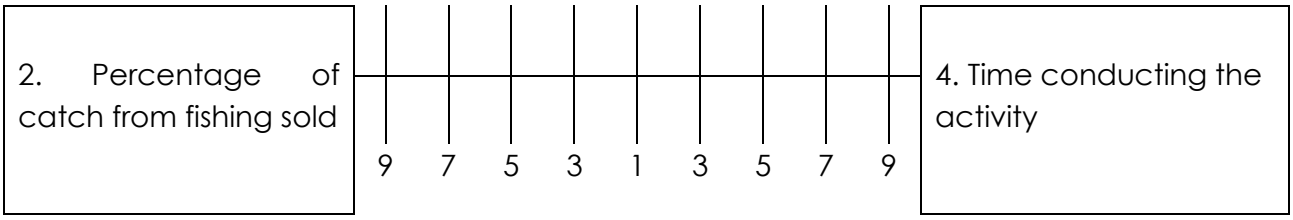
9 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Employment Status or the Time conducting the activity? To what degree you think your choice is important.



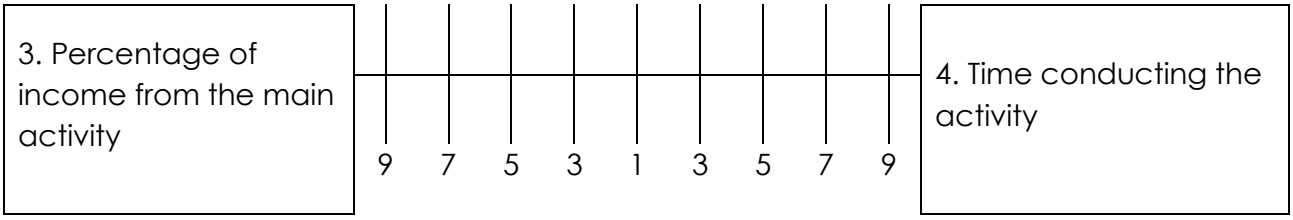
10 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Percentage of catch from fishing sold or the Percentage of income from the main activity? To what degree you think your choice is important.



11 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Percentage of catch from fishing sold or the Time conducting the activity? To what degree you think your choice is important.

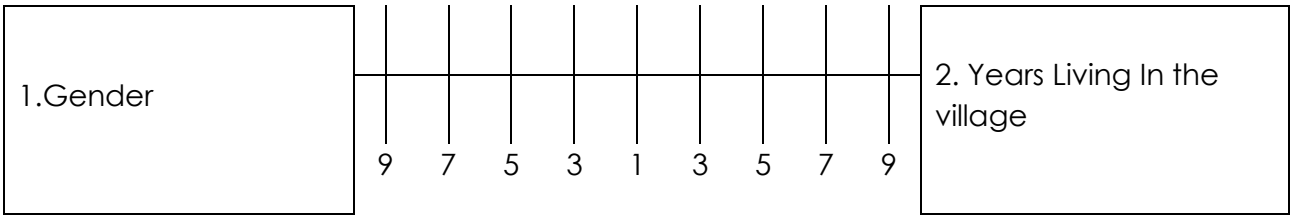


12 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the livelihood of coastal communities of Southern part of Mozambique: In your opinion what is more important the Percentage of income from the main activity or the Time conducting the activity? To what degree you think your choice is important.

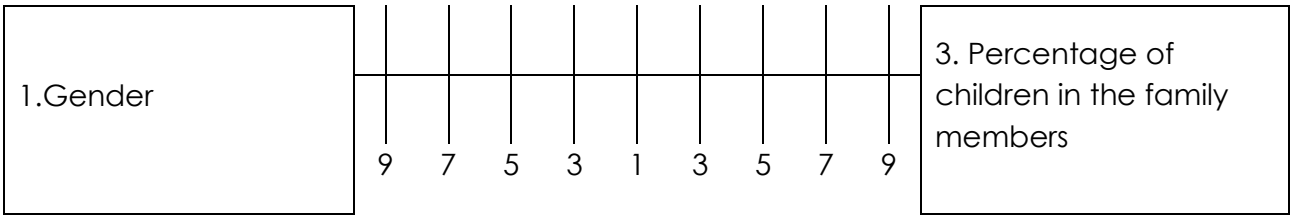


c) Demographic

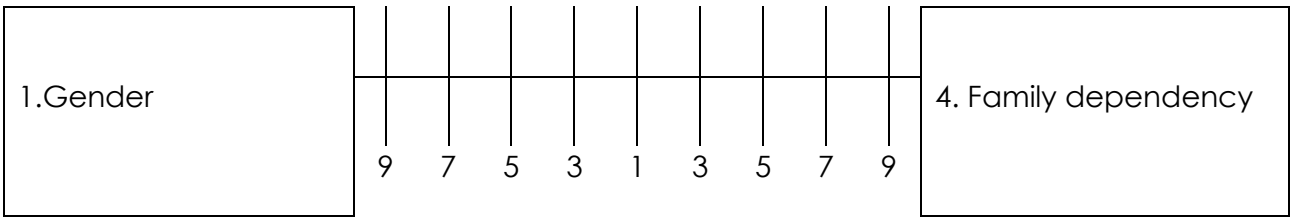
13 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Gender or the Years Living In the village? To what degree you think your choice is important.



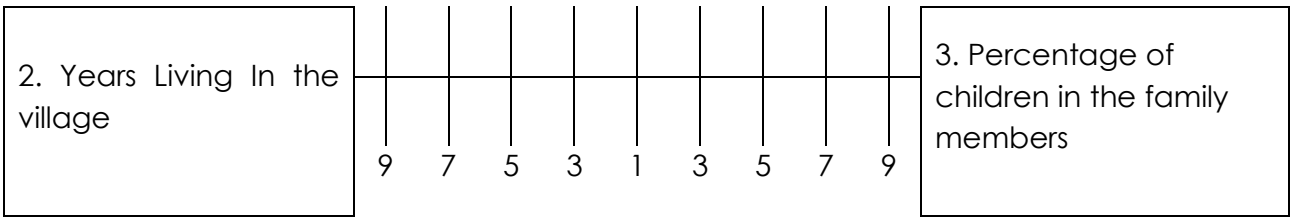
14 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Gender or the Percentage of children in the family members? To what degree you think your choice is important.



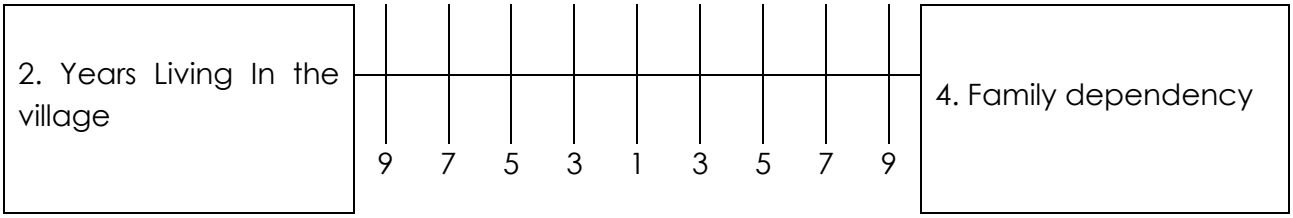
15 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Gender or the Family dependency? To what degree you think your choice is important?



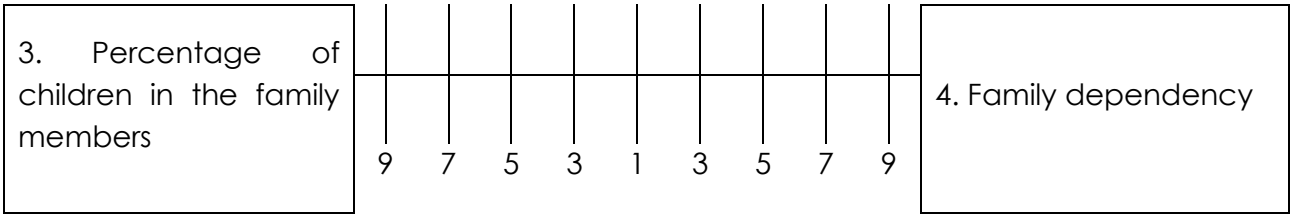
16 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Years Living In the village or the Percentage of children in the family members? To what degree you think your choice is important.



17 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Years Living In the village or the Family dependency? To what degree you think your choice is important?

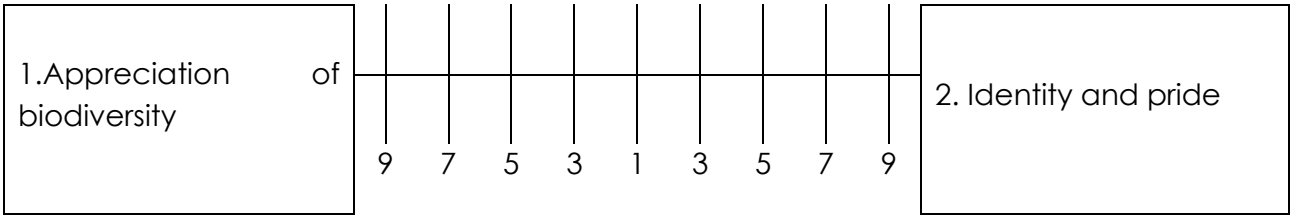


18 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the demographics of coastal communities of Southern part of Mozambique. In your opinion what is more important the Percentage of children in the family members or the Family dependency? To what degree you think your choice is important?

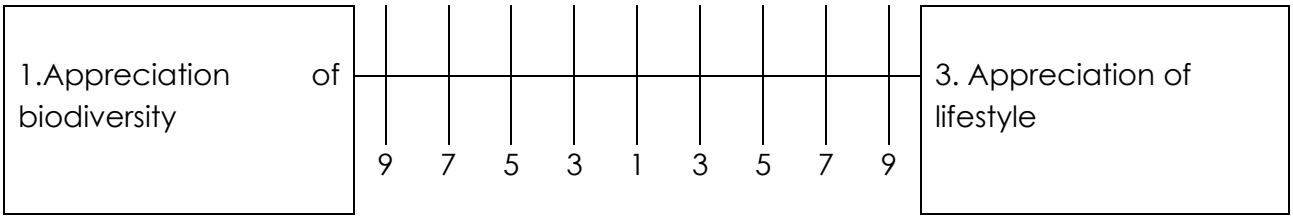


d) Cultural

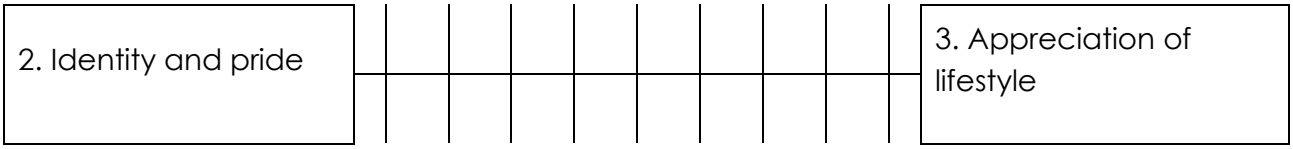
19 Within the different domains there are different indicators that will contribute to the overall sensitive. For example within the cultural domain of coastal communities of Southern part of Mozambique. In your opinion what is more important the Appreciation of biodiversity or the Identity and pride? To what degree you think your choice is important?



20 Within the different domains there are different indicators that will contribute to the overall sensitive. For example within the cultural domain of coastal communities of Southern part of Mozambique. In your opinion what is more important the Appreciation of biodiversity or the Appreciation of lifestyle? To what degree you think your choice is important?



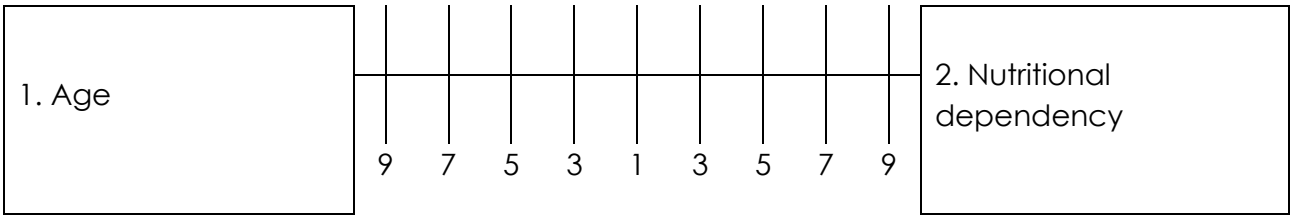
21 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the cultural domain of coastal communities of Southern part of Mozambique. In your opinion what is more important the Identity and pride or the Appreciation of lifestyle? To what degree you think your choice is important?



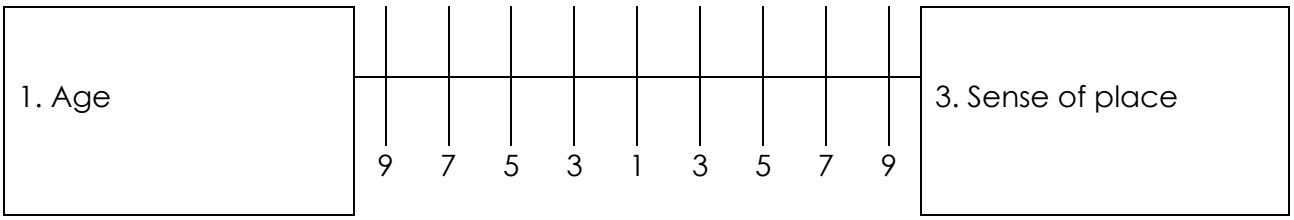
	9	7	5	3	1	3	5	7	9	

d) Health

22 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the health of coastal communities of Southern part of Mozambique. In your opinion what is more important the Age or the Nutritional dependency? To what degree you think your choice is important?

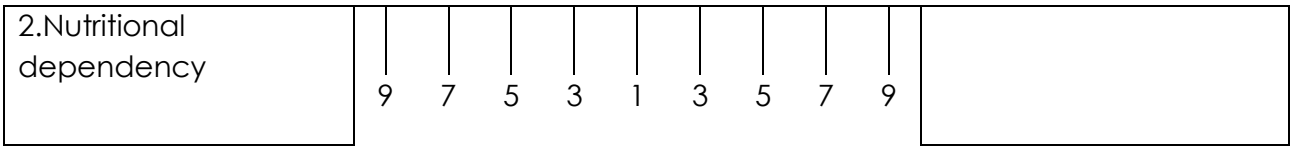


23 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the health of coastal communities of Southern part of Mozambique. In your opinion what is more important the Age or the Sense of place? To what degree you think your choice is important?



24 Within the different domains there are different indicators that will contribute to the overall sensitive. For example, within the health of coastal communities of Southern part of Mozambique. In your opinion what is more important the Nutritional dependency or the Sense of place? To what degree you think your choice is important?

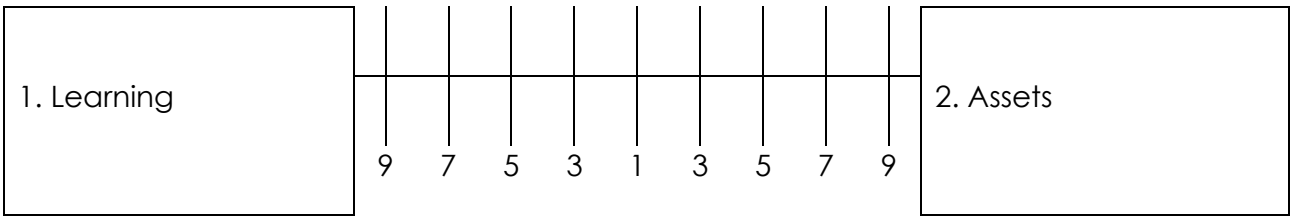
										3. Sense of place



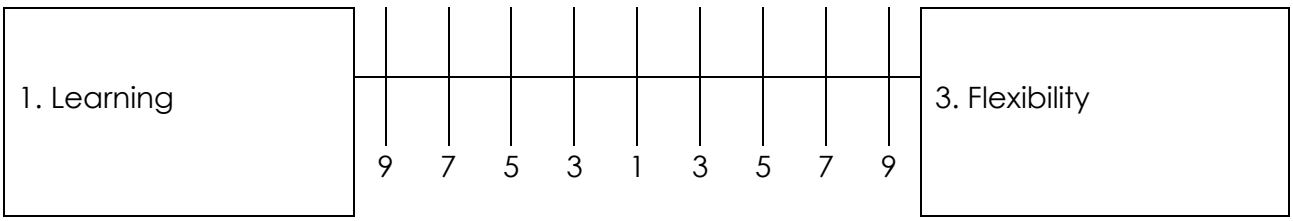
II. Adaptation Capacity

a) Domains

1 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the communities in the southern part of Mozambique, the Learning or Assets? To what degree you think your choice is important.

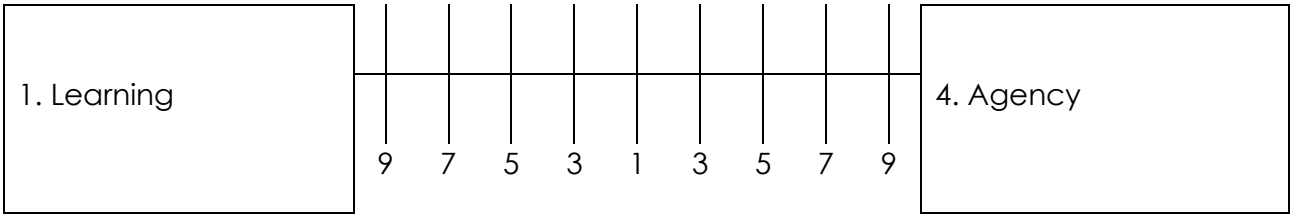


2 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Learning or Flexibility? To what degree you think your choice is important.

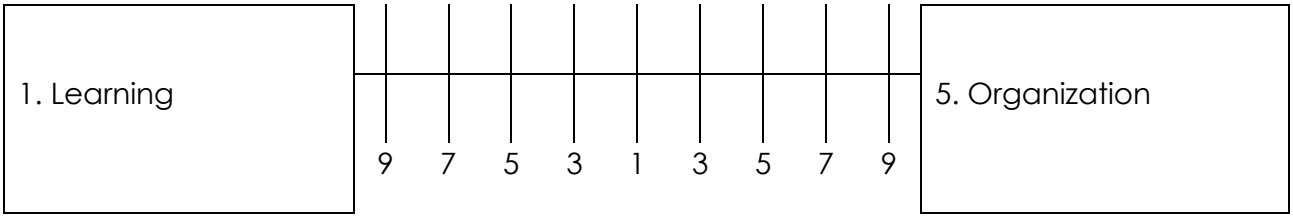


3 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate

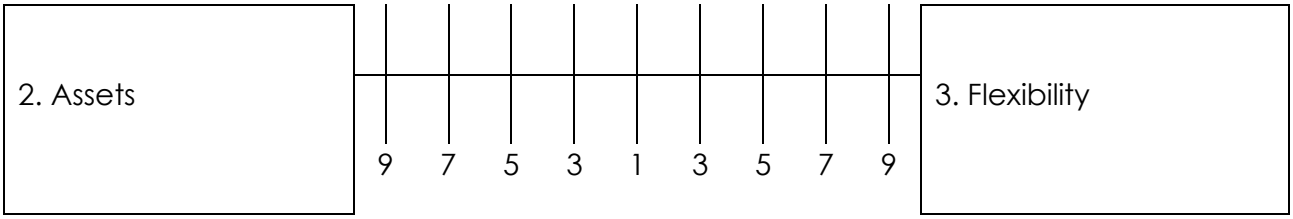
change for the community in the southern part of Mozambique, the Learning or Agency? To what degree you think your choice is important.



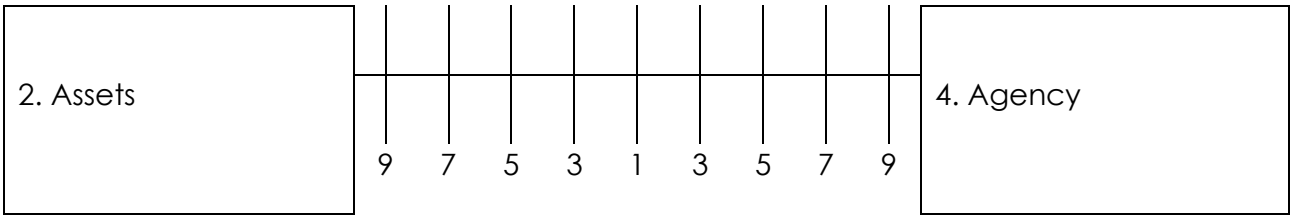
4 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Learning or Organization? To what degree you think your choice is important.



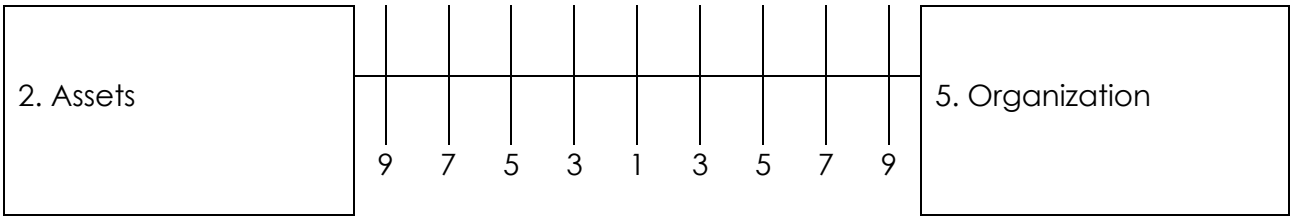
5 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Assets or Flexibility? To what degree you think your choice is important.



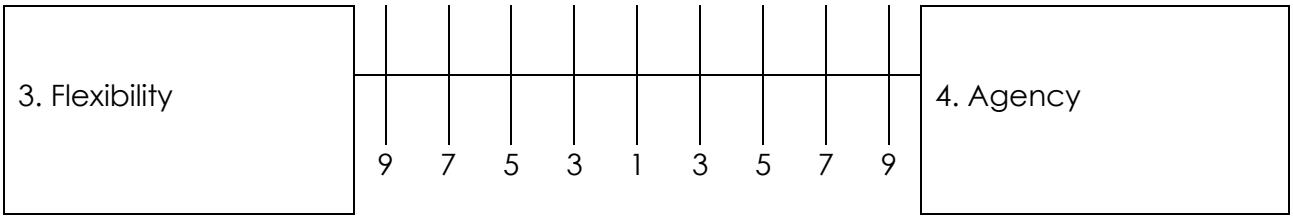
6 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Assets or Agency? To what degree you think your choice is important.



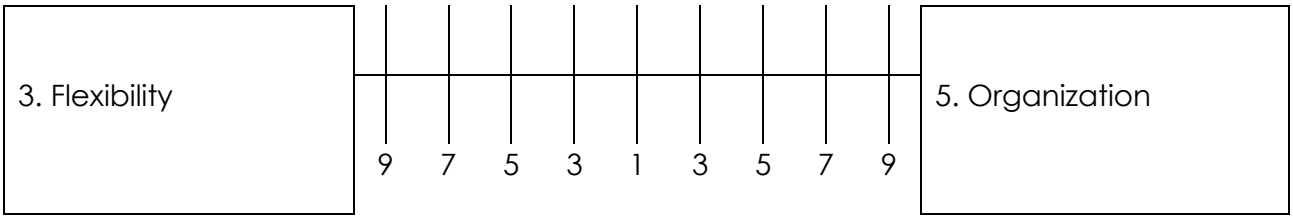
7 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Assets or Organization? To what degree you think your choice is important.



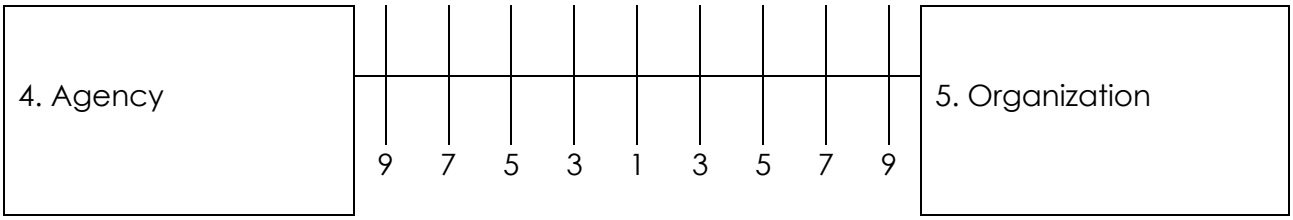
8 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Flexibility or Agency? To what degree you think your choice is important.



9 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Flexibility or Organization? To what degree you think your choice is important.

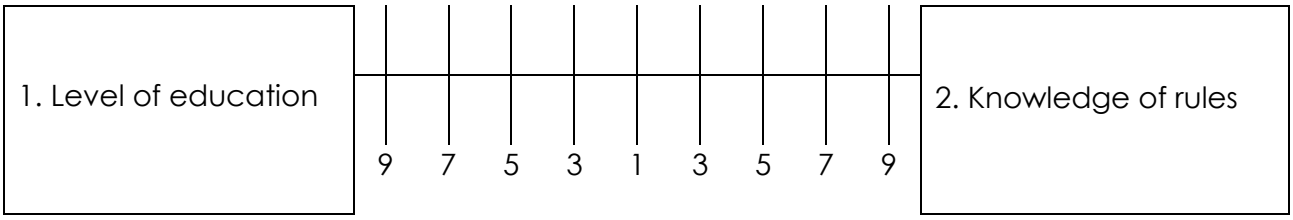


10 There are different aspects that impact the Adaptive capacity of coastal communities. In your opinion what is more important in determining the Adaptive capacity to climate change for the community in the southern part of Mozambique, the Agency or Organization? To what degree you think your choice is important.

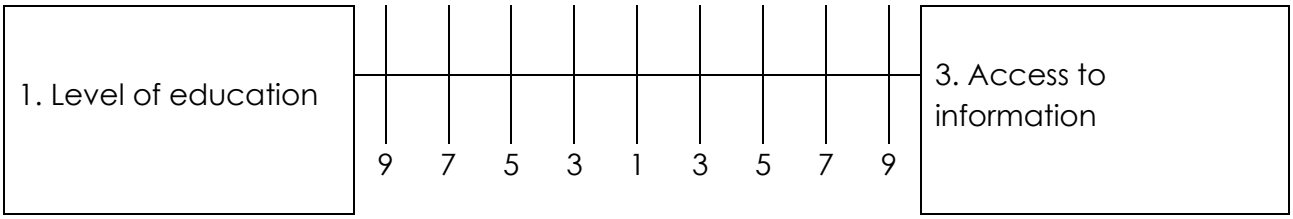


b) Learning

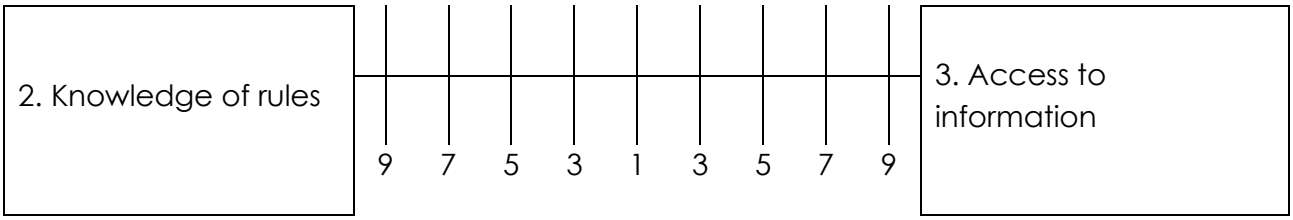
11 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Learning for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Level of education or the Knowledge of rules? To what degree you think your choice is important?



12 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Learning for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Level of education or the Access to information? To what degree you think your choice is important?

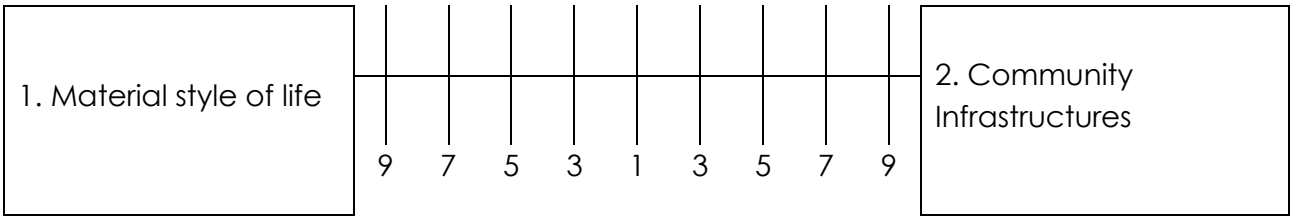


13 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Learning for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Knowledge of rules or the Access to information? To what degree you think your choice is important?



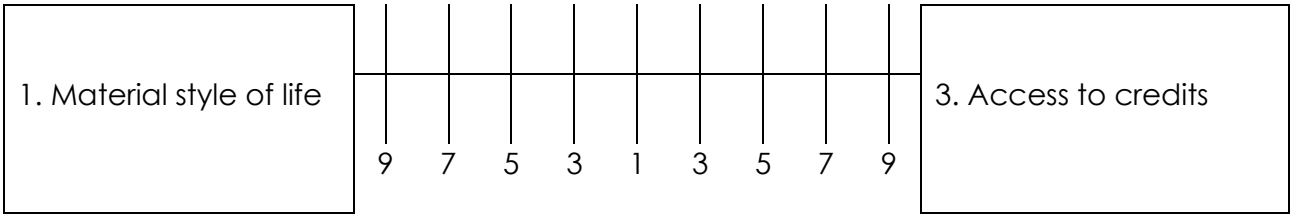
c) Assets

14 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Assets for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Material style of life or the Community Infrastructures? To what degree you think your choice is important?

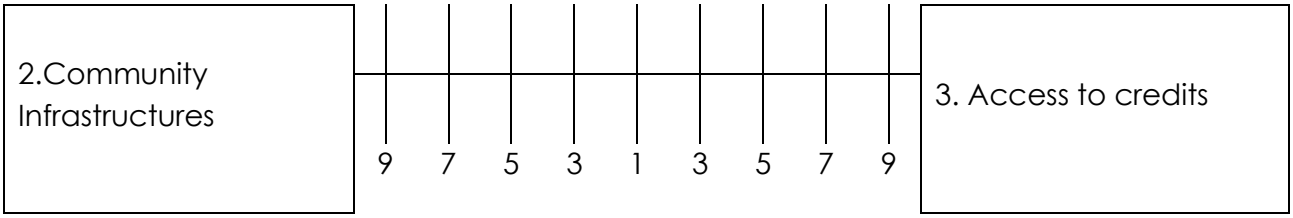


15 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Assets for the coastal communities of

Southern part of Mozambique. In your opinion what is more important the Material style of life or the Access to credit? To what degree you think your choice is important?

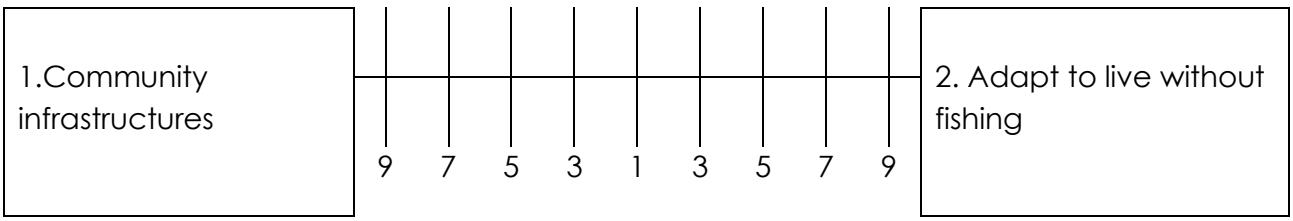


16 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Assets for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Community Infrastructures or the Access to credit? To what degree you think your choice is important?

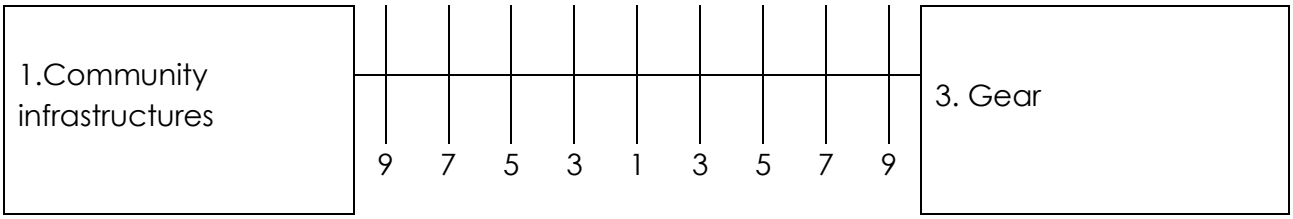


d) Flexibility

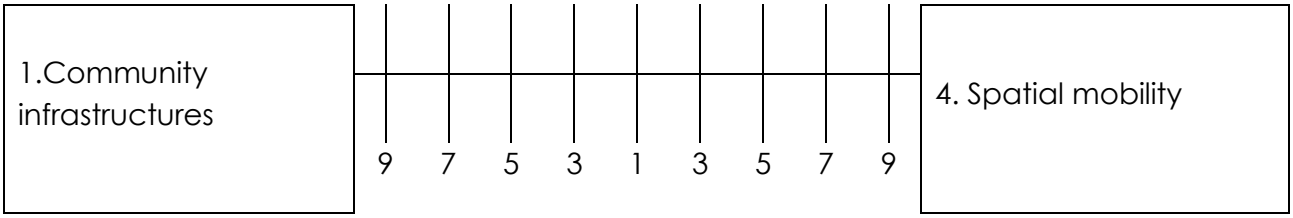
17 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Flexibility for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Community Infrastructures or Adapt to live without fishing? To what degree you think your choice is important?



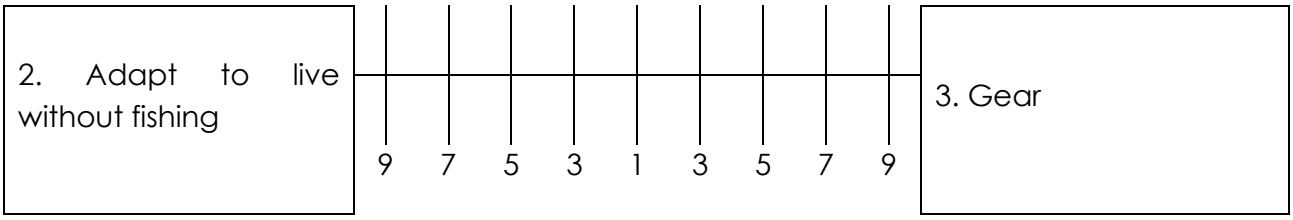
18 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Flexibility for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Community Infrastructures or Gear? To what degree you think your choice is important?



19 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Flexibility for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Community Infrastructures or Spatial mobility? To what degree you think your choice is important?

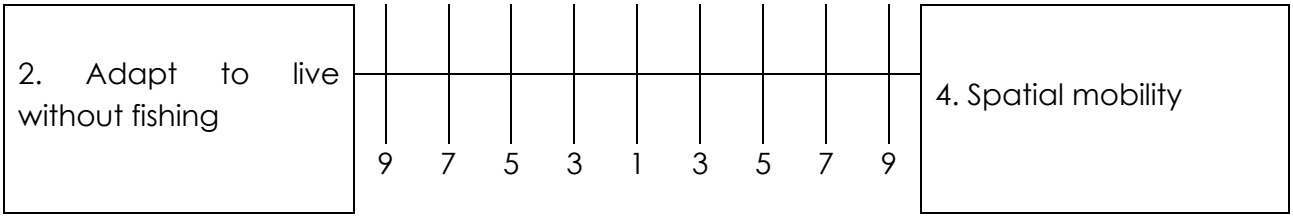


20 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within Flexibility, for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Adapt to live without fishing or Gear? To what degree you think your choice is important?

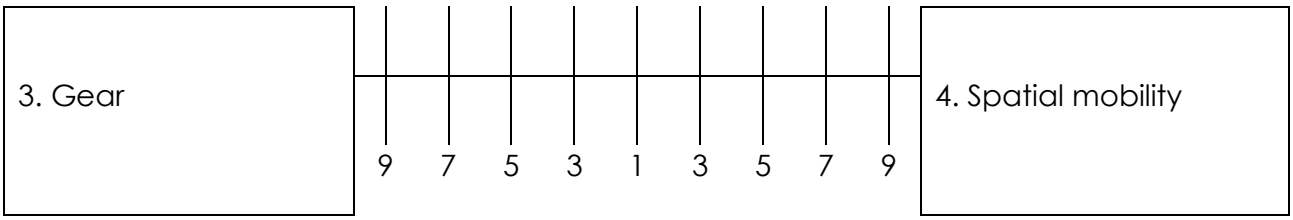


21 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Flexibility for the coastal communities

of Southern part of Mozambique. In your opinion what is more important the Adapt to live without fishing or Spatial mobility? To what degree you think your choice is important?

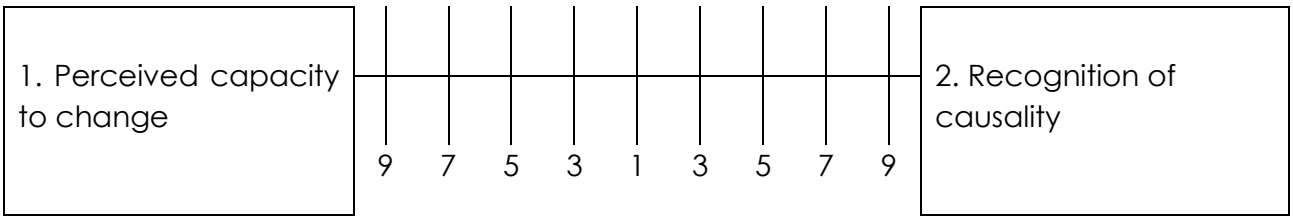


22 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within Flexibility for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Gear or Spatial mobility? To what degree you think your choice is important?

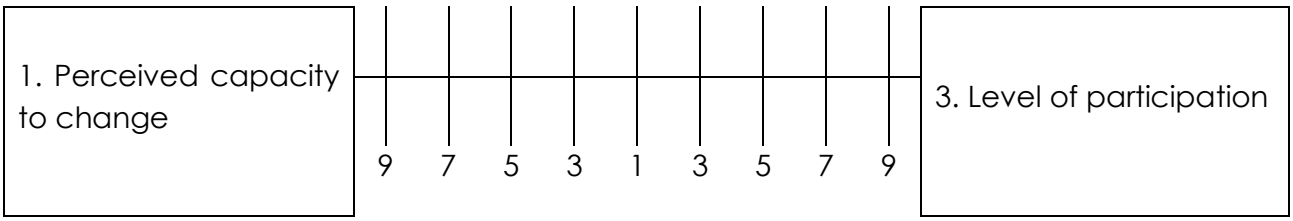


c) Agency

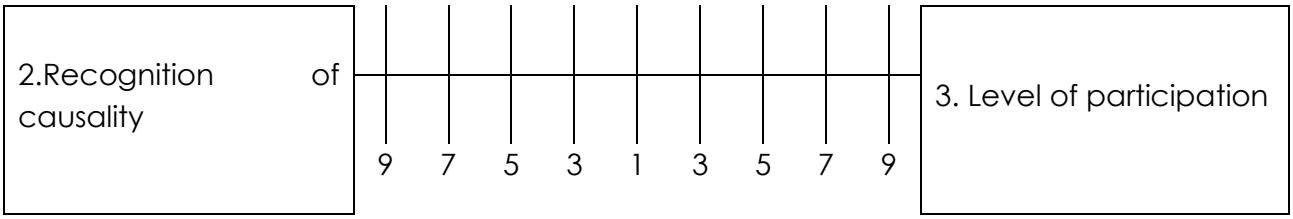
23 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Agency for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Perceived capacity to change or Recognition of causality? To what degree you think your choice is important?



24 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Agency for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Perceived capacity to change or Level of participation? To what degree you think your choice is important?

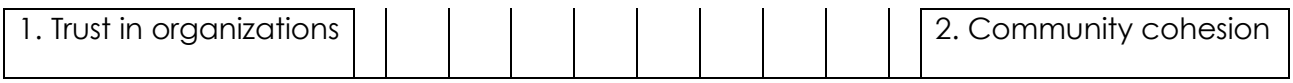


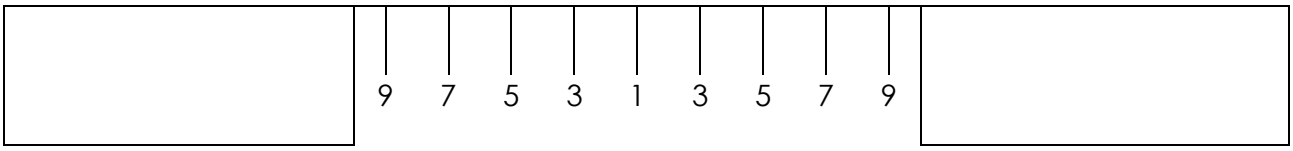
25 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Agency for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Recognition of causality or Level of participation? To what degree you think your choice is important?



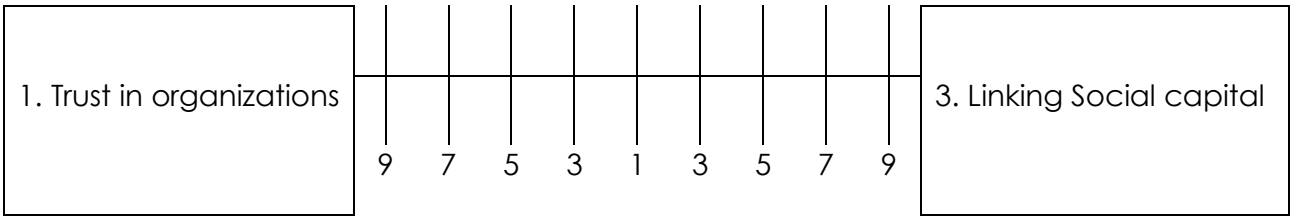
c) Organization

26 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Organization for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Trust in organizations or Community cohesion? To what degree you think your choice is important?

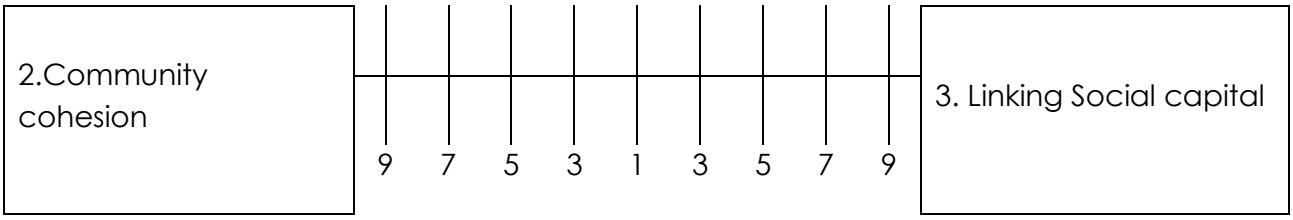




27 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Organization for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Trust in organizations or Linking Social capital? To what degree you think your choice is important?



28 Within the different domains there are different indicators that will contribute to the overall Adaptive capacity. For example, within the Organization for the coastal communities of Southern part of Mozambique. In your opinion what is more important the Community cohesion or Linking Social capital? To what degree you think your choice is important?



Appendix 6 Climate change vulnerability calculation workbook

(Separate Excel File)